THE FINANCE OF BIOTECHNOLOGY:

INVESTMENT IN NEW BIOTECHNOLOGY FIRMS BY BRITISH VENTURE CAPITALISTS - ATTITUDES TO, AND EVALUATION OF, BUSINESS PROPOSALS.

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OCTOBER 1988

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A Thesis submitted for the Degree of
Doctor of Philosophy
1988.

SUMMARY

A notable feature of the recent commercialisation of biotechnology has been the success of 200 or so new firms, established in America since 1976, in exploiting specialised market niches. A key factor in their formation has been the ready availability of venture capital funding. These firms have been instrumental in establishing America's lead in commercial biotechnology. It is this example which Britain has sought to emulate as part of its strategy for developing its own biotechnology capabilities.

This thesis investigated some aspects of the relationship between biotechnology and venture capital, concentrating on the determinants of the venture capitalist's investment decision. Following an extensive literature survey, two hypothetical business proposals were used to find what venture capitalists themselves consider to be the key elements of this decision.

It was found that venture capitalists invest in people, not products, and businesses, not industries. It was concluded that venture capital-backed small firms should, therefore, be seen as an adjunct to the development of biotechnology in Britain, rather than as a substitute for a co-ordinated, co-operative strategy involving Government, the financial institutions, industry and academia. This is chiefly because the small size of the UK's domestic market means that many potentially important innovations in biotechnology may continue to be lost, since the short term identification of market opportunities for biotechnology products will dictate that they are insupportable in Britain alone.

In addition, the data analysis highlighted some interesting methodological issues concerning the investigation of investment decision making. These related especially to shortcomings in the use of scoresheets and questionnaires in research in this area. The conclusion here was that future research should concentrate on the reasons why an individual reaches an investment decision. It is argued that only in this way can the nature of the evaluation procedures employed by venture capitalists be properly understood.

KEY WORDS:

Biotechnology; Small Firms; Venture Capital; Project Assessment and Evaluation.

ACKNOWLEDGEMENTS.

I would like to record my appreciation to the following for their assistance in the preparation of this thesis.

First and foremost thanks are due to my supervisor, Professor Edward Davis, Head of the Corporate Management Division, Aston Business School, and my associate supervisor, Dr. Eric Smith, Head of the Department of Chemical Engineering and Applied Chemistry, Aston University, for their continued help, advice and encouragement throughout the duration of this research.

For financial support which enabled this research to be undertaken, I am grateful to the Economic and Social Research Council.

For their help with the field research undertaken in this study, I would first like to thank Christine Cope Pence for permission to use the Tissue Reproductions proposal, and for her helpful early comments. Similarly, I am grateful to Dr Liam Martin of UMIST, for permission to base the Brookfield Instruments proposal on the DNA sequencer developed by his team. Thanks are also due to Derek Jones, of Aston Technical, Management and Planning Services Ltd. and Colin Gilmour of the Aston Business School for their advice in the preparation of the Brookfield Instruments proposal. For reviewing both proposals at an early stage in their preparation and for the helpful comments and advice they gave, I am most grateful to Adrian Silber and Chrisopher Bloomfield of County Bank, Birmingham. Finally, my sincere thanks must go to the venture capitalists who participated in this study, who took the time both to review the proposals and to explain the venture capital investment process to me.

During the analysis and writing-up of the research findings, Dr David Wilson, of the Applied Statistics Group at Aston, provided extensive help with, and interest in, the statistical analysis of the business plan evaluations. Roger Buckland and Adrian Wells of the Aston Business School also provided helpful advice at various stages of the data analysis. For the many useful discussions we have had on aspects of biotechnology and small business finance, thanks are due to Ian Williams and Jonathan Liu. Many thanks are also due to Colin Hamilton for the considerable help he has given, especially with proof-reading, in the final weeks of preparing this thesis.

Finally, and in addition to those already mentioned, I would also like to record my thanks and appreciation to some good friends at Aston, Manchester and elsewhere for their help in other ways - frequently non-academic, often alcoholic - in completing this thesis.

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ACARD	Advisory Council on Applied Research and Development.
ABRC	Advisory Board to the Research Councils.
BIL	Brookfield Instruments Ltd.
DNA	Deoxyribonucleic acid.
EEC	European Economic Community.
ICFC	Industrial and Commercial Finance Company.
IRC	Industrial Reorganisation Corporation.
MBO	Management buy-out.
NBF	New biotechnology firm.
NEB	National Enterprise Board.
NRDC	National Research and Development Corporation.
OECD	Organisation for Economic Co-Operation and Development.
OTA	Office of Technology Assessment.
OTC	Over the Counter (Market).
rDNA	Recombinant DNA.
RS	Royal Society.
SERC	Science and Engineering Research Council.
TDC	Technical Development Capital.
TRI	Tissue Reproductions Inc.
UK	United Kingdom.
UMIST	University of Manchester Institute of Science and Technology.
US	United States.
USM	Unlisted Securities Market.

CHAPTER ONE

INTRODUCTION: OVERVIEW OF THE PROJECT

1.1 High Technology Industry and the Economy.

As a result of the prolonged economic recession following the oil crisis of the early 1970s, and in the face of growing competition from newly industrialised nations, the traditional 'heavy industry' manufacturing base of developed countries has undergone a prolonged period of contraction. In response, increased emphasis has been placed on the role of 'high technology' industries in maintaining the economic well-being and pre-eminence of the developed world. Throughout the 1970s and 1980s, industries based on advances in electronics (for example, information technology and computer-aided design and manufacture) have attained the highest profile in this process of 're-industrialisation'. However, the impact of semiconductor-based industries could well be eclipsed in the next two decades by advances in the biosciences and the advent of the biotechnology revolution.

Biotechnology-based industries are in no sense new. In the form of brewing and baking, they date back several millenia. In the late 19th and early 20th centuries, biological processes were the major source of supply for a number of bulk chemicals used in, for example, the chemical industry for munitions and dye production. As the petrochemical industry superseded biologically-based manufacturing systems for these commodities in the late 1930s, industrial microbiology maintained its importance as a means of producing a range of fine chemicals, such as amino acids and steroids, and antibiotics. More recently, microorganisms have been exploited as a foodstuff (single cell protein) and in the production of fuels as an alternative to non-renewable fossil fuels (as in the Brazilian 'ProAlcool' programme, which uses the microbial degradation of plant material to produce ethanol for use as a motor fuel).

However, the recent perception of biotechnology as a high technology industry rests on the development in the early 1970s of

a powerful set of new techniques known as recombinant DNA (rDNA) technology. These procedures enable genetic material to be transferred across inter-species boundaries. Consequently, organisms with entirely new characteristics (such as bacteria which excrete human insulin) can be created. An allied technique called cell hybridisation, developed around the same time, allows the fusion of two unrelated cells. In essence, cell hybridisation transfers large, unspecified amounts of DNA across interspecies boundaries, whereas rDNA procedures enable small, specific sequences to be transferred. Hybridisation technology is the basis for the production of monoclonal antibodies, which already play a major role in the diagnosis of disease.

The interaction of these new techniques with rapidly advancing 'traditional' industrial microbiology have led to enormous excitement about the prospects for biotechnology. However, much of what is forecast remains at present speculative. It is unlikely that biotechnology-based processes will have much impact until well into the 1990s. Whilst many notable technical successes have focussed attention on biotechnology in recent years, comparable commercial success has so far been more elusive.

Nevertheless, such is the potential offered by biotechnology that its exploitation is being actively pursued in all developed countries at both national and corporate levels. One important feature of this commercialisation has been the establishment in the United States of a large number (over 150 since 1976) of new entrepreneurial biotechnology firms. Whilst the long term prospects for these companies are hard to predict, there appears to be a consensus that from their ranks will rise the biotechnology equivalents of computer giants such as Texas Instruments. Moreover, these companies have been the driving force for many of the successes biotechnology has so far produced and as such they have been central to developing America's pre-eminent position in biotechnology.

The need to develop new industries has perhaps been felt more keenly in the United Kingdom than in other advanced industrialised nations. At least part of the reason for this is the lack of investment in industry in the post-war years, which meant the UK

was less well equipped to deal with the effects of the post-1974 recession than other countries. Furthermore, there had been a greater neglect of the small firm sector in the UK than in other countries. Throughout the 1970s the qualities of the small firm - its entrepreneurial vigour, its adaptability, its role in job creation and innovation - were increasingly promulgated. The lack of a vigorous small firm sector here could be contrasted to the success of semiconductor-based firms in 'Silicon Valley' in developing America's electronics industry. The new biotechnology firms seemed to be doing the same for America's biotechnology effort. The election of the Conservative administration in 1979 put in place a government overtly sympathetic to the re-establishment of an entrepreneurial climate in Britain which would emulate the American example.

One other factor also needs to be mentioned. A perception had grown up that Britain, although excellent in many areas of basic research, all too often failed to capitalise on the products of this basic research. Frequently these products were subsequently developed overseas with considerable success. For example, cell hybridisation - the basis for monoclonal antibody production - was developed in Britain, but the commercial potential of the technique was unrecognised here. Indeed, it is American companies who now lead the world in monoclonal antibody technology. It was argued that only by creating a class of academic entrepreneurs of the type found on US college campuses could such mistakes be avoided in the future. The 'splendid isolation' of the British academic, that in some sense they were divorced from the commercial implications of their research, could no longer be afforded with the economy in recession and research funding increasingly under scrutiny.

The success of high technology small firms in the US was in no small part due to the availability of long term equity finance in the form of venture capital funding. Historically, such finance has been much harder to come by in Britain. Although the Industrial and Commercial Finance Corporation (ICFC) had been established in 1945 to provide this type of backing, it remained the only major source of such funding in Britain until the mid 1970s. The Scottish and Welsh Development agencies, formed in 1975

and 1976 respectively, and the establishment of a number of offshoots of successful US venture funds in Britain around this time mark the origins of the British venture capital industry of the 1980s. The US-backed funds, such as Venture Founders, were particularly important in that they marked the beginnings of a new form of small company financing - financiers who provided active management advice on a continuing basis ('proactive' funds), even to the extent of recruiting management teams if necessary.

The development of biotechnology-based industries depends on certain long term strategic decisions being made on what areas of research to support and how the results of this research should be exploited to the best advantage. All developed countries have published documents outlining their biotechnology development strategies. In Britain the Spinks report, published in 1980, outlined the strengths and weaknesses of Britain's biotechnology effort. Certain of its recommendations, such as the establishment of a new biotechnology firm along the lines of the American model, were acted upon (in the formation of Celltech in 1980). Others, such as the need to strengthen the academic research base, were largely ignored.

Indeed the Governments resporse to Spinks, published in a White Paper in 1981, was that the development of biotechnology-based industries should be left to private enterprise, that the role of Government was to provide a supportive environment in which market forces should determine how biotechnology was applied. Its emphasis on private enterprise and the market, as opposed to a more coordinated technology development policy (such as that of Japan or Germany), in effect means that the financial institutions - in the guise of venture capitalists supporting academic entrepreneurs - now have a central role in developing Britain's biotechnology capability.

Implicit in this assumption is that venture capitalists in some way are able to recognise the technological merits of a business proposal and are able to balance these merits with the commercial realities of small business enterprise. This applies of course not only to biotechnology but to any high technology company. Biotechnology is an ideal example for study not just because it is

from the new firms which have come into being over the last few years that the major players will emerge over the next twenty years or so. In addition, the products these companies are attempting to develop are for markets which remain speculative, making investment in biotechnology extremely risky.

1.2 Aims of the Research.

This thesis seeks to investigate the nature of the relationship between biotechnology and venture capital. Of particular interest are the reasons why venture capitalists in America funded biotechnology at such an early stage in its development, the extent to which Britain can be successful in following the American example, and factors which account for the recent development of the British venture capital industry. The point at issue which emerges from this discussion and which is focussed on in the fieldwork part of this research is the extent to which venture capitalists, in evaluating biotechnology business proposals, are influenced by the technological characteristics of the proposal in arriving at their decision to commit funds to a new enterprise.

Investigating this made use of two hypothetical business proposals which were evaluated by a group of British venture capitalists. An analysis of their evaluations, employing a range of techniques, is presented. The emphasis throughout is on discovering what venture capitalists themselves identify as key determinants of the decision to commit further resources to investigating these proposals as potential investment opportunities. In addition, a comparison between the evaluation of one of these proposals by British and American venture capitalists was sought.

1.3 Structure of the Thesis.

Chapter two provides an introduction to the development of biotechnology, and how it has come to be seen as the basis for new high technology industries following the advent of gene manipulation techniques.

Chapter three describes how biotechnology came to be placed on the corporate agenda - the development of its high technology association. It will be shown that the factors important in this were, first, a highly public debate on the safety and morality of the new techniques which followed their discovery and, second, interest in how the new techniques could be used to produce the anti-viral and anti-tumour agent, interferon. These two episodes combined to produce a biotechnology 'hype', which provided the basis for the inflow of venture capital funds into new biotech firms in the US. In turn, the entrepreneurial vigour of these small firms established America's lead in the commercial exploitation of biotechnology. In doing so, they prompted interest from other countries, notably Britain, in the role of new firms in the development of new technology industries.

The way in which Britain has sought to develop its resources in biotechnology will then be described. It will be shown that policy initiatives for the exploitation of biotechnology were developed within a policy framework which assigned a key role to small firms and market forces in the development of new industry. This introduces the main topic of this thesis, the venture capital funding of new biotechnology firms in Britain.

Before proceeding to review the literature on venture capital project assessment and evaluation, attitudes to small firms in Britain will be discussed. It will be shown that, during the 1970s, the emphasis on their role in the economy changed as they came to be seen as an agent in economic regeneration and the development of 'sun rise' industries. Chapter four will consider in particular initiatives relating to their financing. The historical attitudes of financial institutions to the funding problems of small companies in Britain will be described, including the shortage of long term equity finance for small firms. The development of venture capital financing in the UK and a profile of the UK venture capital industry indicate the extent of changing attitudes to small firms over the last decade.

Chapter five reviews the literature on project assessment and evaluation procedures used by venture capitalists. The conclusion to be drawn from previous studies is that the main determinant of

venture capital investment is the calibre of the management team involved.

Chapter six draws together the conclusions of the preceding chapters and examines the extent to which venture capital has been committed to new biotechnology firms in Britain. Barriers to their formation are briefly touched on by way of introducing the main points of focus for the fieldwork component of this thesis.

Chapter seven describes the methodology developed to investigate venture capitalist investment activity in biotechnology. The methodology used in this study is based on one previously used in an American PhD dissertation. This made use of hypothetical business proposals to obtain comments from venture capitalists on investment decision making. In this present study, one of the proposals used in the American study, and one newly developed, were sent to twenty one venture capitalists.

Interview transcripts were obtained which described how the participants arrived at their decision as to whether to proceed further with their investigation of each proposal as an investment opportunity. In addition a scoresheet covering individual items in each proposal, used previously in the American study, was completed by a number of the participants. The interviews also covered details of the individual company's project assessment and evaluation procedures and attitudes to investment in biotechnology.

Chapter eight, the first results chapter, provides a survey of the venture capitalists' evaluation procedures, investment activity, investment philosophy, and attitudes to biotechnology as an investment opportunity. Information on the academic and commercial experience of the participants is also presented.

Chapter nine, the second results chapter, presents an analysis of the venture capitalists' comments on each proposal. This takes the form of a content analysis, whereby the items of information contained in each proposal which were identified in the evaluations are isolated. This shows what the participants considered important in reaching their evaluation decision. A

score sheet is developed from this, the analysis of which is presented.

Chapter ten describes the analysis of scoresheets completed by the participants. This provides a supplementary analysis of the evaluation of the two proposals. This chapter also compares the evaluation of the American proposal in the study from which it was originally taken with the evaluation given by British venture capitalists in this present research.

Chapter eleven describes the development of an 'holistic' approach to understanding venture capitalists' evaluation decisions. This seeks to relate the background of the venture capital firm and the individual evaluator to the evaluation given to each proposal. It is contended that future studies of venture capital investment need to take into account the background of the venture capitalist in order to understand the evaluation decision.

Finally, chapter twelve presents the summary, conclusions and recommendations for further research arising from this study.

CHAPTER TWO

A BRIEF INTRODUCTION TO BIOTECHNOLOGY

2.1 Introduction.

The processing of materials by biological agents, biotechnology, supports a wide range of industries. In the early 1970s the potential applications of biotechnology were dramatically increased by the emergence of gene manipulation technology. The aim of this Chapter is to provide an understanding of the scope of biotechnology, and the extent to which the development of these new techniques has altered perceptions of how biological agents can be used as the basis for new industries in the future.

2.2 What is Biotechnology?

The activities of microorganisms, primarily bacteria and yeasts, have been exploited for several thousand years for the preservation of otherwise perishable primary commodities, for example grape juice, milk or animal hides. These could be converted by microbial action into more stable secondary commodities such as wine, yoghurt and cheese, and leather. The techniques of brewing and baking are likewise examples of the craft discipline nature of biotechnology (Levey, 1959). In the late 19th and early 20th centuries, large scale fermentation processes began to be utilised for the production of bulk feedstocks for the emerging chemical industry. More recently, microbes have been used to produce pharmaceuticals such as antibiotics and steroids, fine chemicals including amino acids and vitamins, and enzymes (Stanier et al, 1987).

Over the last 15 years a new term, biotechnology, has entered the vocabulary of science and industry. Biotechnology encompasses the existing activities of fermentation and applied microbiology, but extends beyond the boundaries of these traditionally-based industries. This has come about as a result of advances in our understanding of the molecular basis of life which culminated, in the early 1970s, in the development of a set of powerful new gene

manipulation techniques. These techniques have revolutionised our ability to control and direct living processes, not only in microorganisms but in plants and animals too.

2.3 Defining the "New" Biotechnology.

Biotechnology encompasses a wide range of activities involving the application of a group of techniques and procedures utilising living organisms and derivatives of living organisms in industrial production. Both because of the diversity of these procedures and their potentially wide ranging applications, it is perhaps not surprising that definitions of biotechnology have proliferated. A 1982 Organisation for Economic Cooperation and Development (OECD) report: 'Biotechnology - International Trends and Perspectives' (Bull et al, 1982:67) and a 1984 United States Office of Technology Assessment (OTA) report: 'Commercial Biotechnology: An International Analysis' (OTA, 1984:503) together list 17 such definitions. The OECD defines biotechnology as:

> '...the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.' (Bull et al, 1982:21)

The common theme of this and other definitions is the emphasis given to the commercial application of the results of research. By biological agents, we mean chiefly microorganisms or their constituent parts, although "new" biotechnology also encompasses plants and animals, for example with the possibility of developing transgenic species.

The techniques underpinning the new biotechnologies have emerged from the interaction of a group of previously loosely related disciplines such as microbiology, biochemistry, molecular biology, cell biology, immunology and bioprocess technology (biochemical engineering). Two of these techniques, under the sobriquet of genetic engineering, are recombinant DNA (rDNA) and cell fusion technologies. The third, bioprocess technology, refers to the scaling up of production methods and the isolation and purification of products. Table 2.1 on the next page summarises these techniques.

Table 2.1 Techniques stimulating the development of biotechnology.

1. Gene manipulation.

   A. Recombinant DNA technology.

   (i) Gene manipulation
   (ii) Protein structural modification (protein engineering)

   B. Cell fusion technology

   (i) Monoclonal antibody production
   (ii) Other animal cell fusion
   (iii) Protoplast (plant cell) fusion

2. Bioprocess technology.

   (i) Product separation and purification (downstream processing)
   (ii) Immobilised enzyme and cell catalysis
   (iii) Tissue culture
   (iv) Computer linkage of reactors and processes
   (v) New biocatalytic reactor design

3. Other related innovations.

   A. Bioelectronics

   (i) Biosensors (sensing with the aid of biological molecules)
   (ii) 'Biochips' (biologically-based semi-conductors)

   B. Biomaterials

Derived from: Dunnill, P. and Rudd, M., 1984, 'Biotechnology and British Industry' p.13.

2.3.1 Gene manipulation technologies.

Gene manipulation technologies enable genetic material to be transferred between different species, making it possible to 'tailor make' organisms for with entirely new characteristics. rDNA technology is concerned with the transfer of small pieces of DNA, either singles genes or groups of genes. Cell fusion technology recombines the entire genetic complement of one species with another. Already these techniques have been used to:

(i) offer complementary or alternative production and manufacturing processes to those currently in operation. For

example, human insulin can now be obtained from bacteria which have had this gene inserted into them;

(ii) improve the efficiency of processes which use biological systems at present, and make economically viable processes which are currently inefficient compared to alternative production processes (such as single cell protein production);

(iii) make possible the manufacture of previously unobtainable goods and services. Examples here are the anti-viral and anti-tumour agent interferon, and monclonal antibodies;

In the future it is also likely that the techniques will be used in the manufacture of previously unknown goods and services, as knowledge and understanding of protein structure-function relationships improves. Therefore, whilst the feasibility of rDNA and cell fusion procedures has already been proven, it is important to understand that the early successes outlined above are essentially demonstration projects, and as such are exemplars of an, as yet, unrealised potential.

But creating a recombinant organism is only one aspect of the new biotechnology. Having a bacterial culture secreting insulin in a test tube or laboratory-scale bioreactor is one thing. Scaling up the production process to produce insulin commercially in 10,000 litre bioreactors presents entirely different sets of problems. It goes without saying that unless these laboratory bench procedures can be scaled up economically, the commercial potential of any new procedure will not be achieved. Bioprocessing technology is concerned with overcoming these problems.

2.3.2 Bioprocessing technology.

Bioprocessing is a term which embraces the procedures of 'traditional' biotechnology, such as fermentation, antibiotic production and single-cell protein manufacture. However, the advent of rDNA procedures has led to a re-awakening of interest in bioprocessing as a manufacturing method for two reasons:

(i) in many cases, it is through bioprocessing that rDNA technology will obtain its practical manifestation - bioprocessing is needed to make the product and isolate it;

(ii) in turn, bioprocessing as a method of manufacturing will be revolutionised by rDNA techniques;
   - enhancing the efficiency and usefulness of existing processes (such as antibiotic and fine chemical production),
   - improving the technical efficiency of certain, currently uncompetitive, bioprocesses, making them more economically competitive with existing chemical processes (such as bulk chemical production),
   - creating completely new products (such as monoclonal antibodies) or modifying important existing ones.

It is apparent, therefore, that the commercial success of biotechnology will depend on the development of, and interaction between, rDNA and related techniques on the one hand, and new bioprocessing modes on the other.

2.3.3 Biotechnology support services.

An important consequence of the intensive research efforts being undertaken in biotechnology has been the considerably increased demands placed on biotechnology support services. New types of reagents, instrumentation and other types of specialised equipment, information services and data management systems are all needed. In itself this has led to the development of a new infrastructure of companies meeting industry's needs. A large number of the new biotechnology firms (NBFs) created in the United States since 1976 have been producers of either speciality biochemicals, such as oligonucleotides and restriction enzymes, or new types of automated instrumentation, for example DNA synthesisers and protein sequencers. Around 25% of the total reagents used in biotechnology research in America are produced by NBFs and this figure is likely to increase as new market niche opportunities emerge. The majority of the commercially profitable NBFs that have emerged thus far have been engaged in support services (OTA, 1984:84-91).

Investment in NBFs operating in support services has provided tangible evidence of the returns obtainable from investing in biotechnology from sales of actual products. Psychologically this is important as the majority of biotechnology investments - for example in NBFs developing products based on rDNA techniques - are in projects where products will only come on-stream in the medium to long term.

2.4 Summary.

Biotechnology, an industrial activity which dates from antiquity, has been revolutionised by the advent of gene manipulation technologies. Through the development of recombinant DNA and cell fusion techniques a large number of new products and processes will develop from biotechnology-based industries. In Chapter three which follows, we will examine how the commercial perspective of gene manipulation technology arose.

CHAPTER THREE

THE COMMERCIALISATION OF BIOTECHNOLOGY

3.1 Introduction.

The previous Chapter showed that the advent of gene manipulation techniques has led to a radical reappraisal of how biological systems can be used in the production of goods and services. The aim of the next two Chapters is to explore some of the influences which helped determine Britain's approach to developing its biotechnology capabilities, in particular the emphasis given to the role of venture capital-backed small firms. Chapter four will look at how attitudes to small firms have changed in Britain over the last twenty years, and factors which have encouraged the development of the British venture capital industry. First, however, this present Chapter will look at why venture capital-backed firms have come to be seen as having a role in the development of biotechnology in the UK.

The key determinant of British thinking in this respect has been the success of new firms in the US in exploiting biotechnology. For this reason, this Chapter will look at why these American firms have been so successful in attracting venture capital funding. It will be shown that these firms were both founded and funded as a direct consequence, first, of concerns over the safety of recombinant DNA techniques. This helped create a commercial perspective for what were initially laboratory techniques. The second major influence on venture capital's interest in biotechnology in the US was the anti-viral and anti-tumour agent, interferon.

3.2 New Biotechnology Firms in the United States and the Development of Biotechnology.

Efforts to exploit the commercial opportunities offered by recombinant DNA (rDNA) techniques began within a very short time of their discovery. The lead was set by a number of new biotechnology firms (NBFs), established by scientist/

entrepreneurs seeking to cash in on their own and their colleagues expertise. The first of these, Genentech, was formed in 1976.

NBFs have been central to the dominance America has achieved in biotechnology. In recognising the commercial potential of academic research, and being prepared to take the risk of developing it, they performed a vital technology transfer function. NBFs were, in essence, 'research boutiques' for larger, established companies who were unwilling at that time to invest in their own in-house research programmes. This in turn determined the characteristics of NBFs, as being highly research orientated firms (see table 3.1 below) generating most of their income through collaborative agreements or licensing arrangements rather than through direct product sales (as shown in table 3.2 on the next page). Revenues from contract research, interest on cash obtained in private or public stock offerings, various venture capital sources and new public stock offerings represented the major source of working funds for these companies in the early years of their existence.

Table 3.1 Capital expenditures, R&D budgets and operating revenues of nine new biotechnology firms operating in the United States, fiscal year 1982 (millions of dollars).

New biotech firm*	Capital expenditures	R&D budget	Operating revenues	R&D as a % of operating revenues
Biogen	8.7	8.7	12.1	72
Cetus (1)	22.9	25.9	16.0	143
Enzo Biochem	0.09	1.2	0.3	400
Genentech	31.8	31.9	28.8	111
Genetic Systems	0.46	3.9	2.2	177
Genex	1.8	8.3	5.2	160
Hybritech	1.44	5.0	3.1	161
Molecular Genetics	1.4	2.8	0.66	424
Monoclonal Antibodies	0.57	1.1	0.26	423

*All formed prior to 1980.

(1) Although formed in 1973, Cetus is usually regarded as an NBF.

Source: Office of Technology Assessment (OTA, 1984), 'Commercial Biotechnology: An International Analysis', table 42, p.271.

Table 3.2 Breakdown of revenues and net income/losses for 10 new biotechnology firms in the United States, fiscal year 1982 (millions of dollars).

New biotech firm	Operating revenues: Revenues from research	Contract revenue as a % of total revenues	Revenue from product sales or royalties	Total	Interest income	Total revenues
Biogen	12.1	58.8		12.1	8.5	20.6
Centocor	2.4	84.2		2.4	0.45	2.85
Cetus	15.2	46.5	0.79	15.99	16.7	32.7
Enzo Biochem	0.1	11.2	0.17	0.27	0.62	0.89
Genentech	28.8	88.3		28.8	3.67	32.6
Genex	5.2	85.3		5.2	0.67	6.1
Hybritech	1.3	27.4	1.8	3.1	1.6	4.75
Molecular Genetics	0.66	61.0		0.66	0.42	1.08
Monoclonal Antibodies	0.10	1.5	0.16	0.26	0.39	6.5

Source: Derived from Office of Technology Assessment (OTA, 1984), 'Commercial Biotechnology: An International Analysis', Table 41, p.270.

The combination of these new, research intensive companies and the production, marketing and regulatory expertise of established US pharmaceutical and chemical companies have been complementary in establishing America's lead in the commercial exploitation of biotechnology.

3.3 Factors Encouraging the Formation of New Biotechnology Firms.

The formation of new, high technology, firms in America has been facilitated by a number of features which are unique to the American economy, which has an environment more favourable to new firm creation than that found in any other country. These features include:

(i) the existence of very large domestic markets;
(ii) the availability of private wealth for start-up firms;
(iii) the availability of private risk capital;

(iv) the existence of over-the-counter and other markets for raising equity capital and realising venture capital investments;
(v) mobility of personnel between academia and industry;
(vi) willingness amongst academics to become entrepreneurs;
(vi) large government expenditure programmes (Rothwell and Zegfeld, 1982:36-37).

Some of these factors, as they relate to NBFs, are described below.

3.3.1 Access to markets.

America's pre-eminence in biomedical research and the massive resources it commits to its research effort makes this the world's largest domestic market for biotechnology products. As the 1982 Organisation for Economic Co-operation and Development (OECD) report put it:

> '...the health system in the USA is probably the largest and wealthiest and has the most demanding market for drugs, instruments and equipment in the world. Here, and elsewhere, healthcare has played a role for biotechnology analogous to the military demand on the development of the electronics industry...'
> (Bull et al, 1982:57)

An example of this is that around 50% of biotechnology instrumentation sales are in the US (OTA, 1984). In contrast, the establishment of NBFs in Europe and Japan is considerably more difficult as domestic markets for such products are insufficient to support small business growth. Reliance on, and access to, export markets discourages both the establishment of NBFs outside the US and their attractiveness to potential investors.

3.3.2 The entrepreneurial culture.

Establishing NBFs was also aided by an entrepreneurial culture which is deeply entrenched in the American psyche. For example, and in contrast to the British situation, it has long been accepted by many American academic institutions that researchers should be free to exploit their work and gain from it financially.

Bullock's study of academic entrepreneurship in America (Bullock, 1983) notes how both the Massachusetts Institute of Technology and Stanford University in California adopted a supportive attitude towards individual academic enterprise as early as the 1930s. The existence of this favourable environment led to a gradual accumulation, in the vicinity of these institutions, of entrepreneurs with experience of managing risky research based companies - people who had technical, management and marketing expertise as well as accumulated capital. Over time, this developed into a network of small research-based company entrepreneurs. It was from this network that professional venture capital firms began to emerge in the early 1960s.

3.3.3 The influence of the semiconductor industry.

Small firms have also played a key role in the development of other high technology sectors in America, notably semiconductor-based industries. Compared with medium and large sized firms, not only have small firms made a disproportionately large contribution to the total number of important inventions, they are also more efficient innovators (Freeman, 1982).

The strong small firm sector involvement in developing biotechnology in the US has led to parallels being drawn with the earlier successful commercialisation of semiconductor technology. In both cases small firms have:

(i) contributed to the development of basic and applied research;
(ii) facilitated the transfer of technology to a number of different industries;
(iii) borne the risk for late entrants into the respective technologies and developed markets for them;
(iv) increased the level of competition and, in so doing, have accelerated the pace of technological advance (OTA, 1984:97).

Because of these similarities, investor expectations have been shaped to some degree by earlier favourable experiences of investing in new semiconductor firms around "Silicon Valley" and

other locations in America. However, as table 3.3 shows there are also a number of substantial differences between the development of the two. Mainly because of the longer time horizons and greater regulatory requirements involved, biotechnology projects face considerably more challenges and greater uncertainty. Nevertheless, both are a testament to the entrepreneurial vigour of the American small firm.

Table 3.3 A comparison of some aspects of the development of semiconductor and biotechnology-based industries in the United States.

Semiconductor-based industries	Biotechnology-based industries
(a) Arose from a fundamental invention (the transistor) made at a major industrial laboratory (American Telephone and Telecommunications' Bell Telephone Laboratory in 1947). Most subsequent product and process innovations made by industry.	Arose from fundamental biomedical research in universities. Early expertise resided primarily with university-based staff.
(b) Development could be tied in with US national objectives - military and aerospace needs.	No clear link between developing biotechnology and national policy objectives.
(c) Early commercial exploitation of semi-conductors limited to one industrial sector, telecommunications. Bell effectively a national laboratory for the semi-conductor industry.	No equivalent.
(d) Many new semiconductor firms formed to market a definite product. Relatively little capital needed because Federal contracts freely available.	Mostly started as R&D houses with the objective of determining how to make product(s). In general, amount of capital needed to bring products to the market will be much higher.

Table 3.3 (continued)

(e) Characterised by numerous specific Federal policy incentives encouraging commercialisation (eg. loans, tax policy).	No parallel.
(f) Federal funding through NASA and Department of Defense: however, relatively little problem with small firms commercialising this research.	Federal funding of biomedical research in universities meant problems in exploiting publicly-funded research. Also, commercial confidentiality, patenting, industry funding of academic research have presented major problems.
(g) Federal government provided funding for production and a first market for products.	Federal government does not provide substantial funds for development of production facilities. Neither does it provide a first market for biotechnology products.
(h) Affects a relatively small number of industrial sectors.	Affects a far wider number of industrial sectors.
(i) Few regulatory requirements.	Federal government plays an important role in the regulation of products (eg. extensive regulation and testing required for pharmaceuticals).

Source: Derived from Office of Technology Assessment (OTA, 1984) 'Commercial Biotechnology: An International Analysis', Appendix C, p.531-541.

Other differences are, as Hay (1984) suggests, that biotechnology's unique characteristics relate to the 'newness' of the technology, which makes determining the relevance of the technology to the marketplace difficult in many instances. In addition, the lead times for the development of new products for the healthcare, agriculture and food industries are substantially longer due to a combination of regulatory requirements and a highly conservative marketplace.

One feature of the establishment of NBFs is, however, quite unique. This is that over 100 NBFs were established between 1976 and 1982, with in excess of $2 billion invested in them. Yet, as tables 3.1 and 3.2 showed, these firms were highly research orientated. Income they derived from sales of actual products was insignificant, in most cases non-existent. This indicates that much of this investment was made in the absence of any firm evidence that rDNA techniques could actually be commercialised in a way that would offer returns to the investor. In turn, this would suggest that the factors described so far can only partly explain why much of this investment was made.

In fact, it can be shown that much of this early commercial interest - and financial investment - in biotechnology in the US may be accounted for by two factors; the rDNA controversy, and interferon. The former was a highly public debate which surrounded the development of the new rDNA techniques. The latter, an immunoprotein with anti-viral and anti-tumour properties, was one of the first proteins targetted for exploitation by the NBFs. Together, they helped shape both scientific and public perceptions of the commercial possibilities offered by the new techniques.

3.4 The Recombinant DNA Controversy.

The rDNA controversy arose initially from expressions of concern over hazards which were thought to be associated with a series of experiments, designed to investigate mechanisms of gene regulation, made possible by gene manipulation. Although disquiet over the safety of new technologies is in no sense unusual, this episode was unique in many respects. From 1974 to 1976, most research involving rDNA was the subject of a voluntary moratorium. This is thought to have been observed unanimously throughout the scientific community. That a moratorium was called in the first place and that it was observed with this degree of consensus, in a research field at such an early stage in its development and with such potential, was unprecedented. But what makes this such a truly remarkable episode is that it was the practitioners of the new techniques themselves who called for the moratorium.

It was during this period that a perception of the commercial potential of the new techniques emerged within the scientific community. From being "socially conscious" in 1973 (Singer & Soll, 1973), that is, concerned about the potential hazards and impacts of their new technology, scientists had become, by the lifting of the moratorium in 1976, commercially conscious. As Krimsky writes in his comprehensive account of the rDNA debate:

> 'In the early stages of the DNA controversy, scientists were balancing concerns about risks against intellectual benefits of research. But as the public gained a greater understanding of the potential risks, through increased media coverage and the sporadic flare-ups in local communities, scientists began focusing their attention on the social benefits. They cited the opportunity costs to society if this research were restrained. These costs would take the form of delayed discoveries that might result in cures for serious diseases or in developments of medically important products that the new technology was certain to spawn.'(Krimsky 1982:285)

However, in arguing that research should be allowed to recommence, it is clear that many of the scientists involved over-emphasised the benefits of rDNA research. This was not simply an example of the difficulties of communicating scientific information, of the scientists making 'objective' pronouncements about rDNA which were then misinterpreted. Undoubtedly misinterpretation did account for some of the hyperbole of the rDNA debate - even the most cautious scientific 'maybes' have a tendency to become public 'definitelys'. Rather, many of the scientists involved deliberately constructed an image of genetic engineering, which had a veneer of scientific respectability and objectivity, but which was in effect part of a public relations exercise which would add weight to their argument that research should be allowed to recommence without restriction. Nevertheless, it was from this that the perception of commercial possibilities emerged:

> '... the discussions of the risks and benefits of the research in public forums, hearings and the media stimulated interest among investors, industrialists and scientists in the possible applications. A number of biologists never before involved in applied research began to consider commercial uses of their work. In some instances, the early results of such efforts to produce substances with important human medical applications were reported directly to the press and to

> Congressional committees engaged in legislative hearings even before they were published in scientific journals, in order to bolster the argument that the benefits side of the research outweighed the risks.' (Weiner, 1981:77)

One important feature of the scientists' lobby was that it had begun to focus on a number of products which were to be among the first the NBFs would work with - the demonstration products of biotechnology. These included human growth hormone, human insulin and human interferon (Panem, 1984:26). However, in the mid-1970s there was no guarantee that rDNA techniques could be successfully exploited for the manufacture of these products. Numerous potential technical difficulties - of how to isolate the required genes, how these could be introduced into bacteria, whether the bacterial host would express the cloned gene, and whether the gene product would be biologically active - meant that there was no evidence that functioning human proteins could be obtained by gene cloning.

It is, therefore, some measure of the effectiveness of the scientists' lobby that it was not only successful in repealing the moratorium. When research did recommence, financial institutions had been made aware of the power of rDNA technology and were willing to consider putting money into NBFs who sought to manufacture these products, despite the uncertainties involved.

In summary then, the moratorium and rDNA debate had given genetic engineering a momentum of its own, one where rigorous evaluation of the claims made for the power of rDNA techniques and the products they would produce was lost. The 'biotech hype' was born.

However, public concern, rather than being pacified, was heightened by the scientists' pronouncements:

> 'It is ironic that the entrepreneurial scientists were no doubt partly responsible for the public reaction [to rDNA]. They were promoting the rDNA technique as unique, powerful and revolutionary. They set it apart from more conventional methods. They promoted and participated in its vigorous industrial exploitation. Meanwhile public skepticism grew over whether the commercial developments in biology would escape the

adverse environmental effects that similar developments in chemistry and physics had produced' (Krimsky, 1982;343-4).

As a result, when research did recommence in the summer of 1976 the controversy intensified, particularly in the United States. Plans to establish academic and commercial genetic engineering facilities were often met with strong local resistance. Threats of wider legislation and control of research loomed in the shape of numerous Senate hearings on the subject and direct Congressional involvement in the form of a series of increasingly stringent regulatory bills passed in 1977 and 1978.

In response, the scientific lobby was strengthened by three factors. First, there was an urgency imparted to research as a result of the large amounts of commercial finance which had become involved in, what was still essentially, basic research. As a result, enormous strides were made in developing rDNA techniques in a relatively short space of time such that, in 1978, both human growth hormone and insulin were cloned.

Second, the cloning of these products demonstrated the social (and commercial) benefits of rDNA research. In contrast, no evidence had been found to substantiate the existence of the potential hazards which had led to the moratorium in the first place. Indeed, the possibility that special hazards were associated with rDNA experimentation were being progressively down-played.

Third, any public anxiety over these potential dangers was increasingly tempered by the fact that rDNA procedures appeared to offer the best option in securing supplies of the 'anti-cancer drug' interferon.

3.5 The Role of Interferon in the Development of Biotechnology.

Interferon is a protein produced by the body in response to viral infection. Besides its anti-viral properties it also appears to have some effect against certain types of cancer. However, it is produced in vanishingly small amounts and is only effective in the species from which it is derived. It was because of the problems involved in manufacturing sufficient quantities for testing - in

1978 there was enough produced worldwide to treat just 50 cancer patients (Yanchinski, 1980) - that its effectiveness as a therapeutic agent remained unproven. Clearly, a breakthrough in production technology was needed.

Two approaches to solving this problem were attempted. The first used human cell culture, developed during the 1960s and 1970s to produce a range of biologicals, such as vaccines. In a similar way, it was possible to mass produce cells in culture and use them for the manufacture of interferon. Both because of the expense of building plant for cell culture, and because this mode of production required only an extension of pre-existing expertise, cell culture was favoured by established large firms seeking to produce interferon. In the UK, the pharmaceutical company Wellcome (who had been heavily involved in interferon research since shortly after its discovery) were pre-eminent in this (Newmark, 1981). The second approach, technically more difficult and less well understood, was to clone interferon using rDNA techniques. It was this approach which was favoured by the NBFs.

It should be remembered that, at the time of the formation and funding of the first NBFs (between 1976 and 1980) there was considerable uncertainty as to whether or not functioning human proteins could be obtained by rDNA procedures. Equally, evidence as to the clinical effectiveness of interferon, as either an anti-cancer or an anti-viral agent, was equivocal. Thus, early attempts by the NBFs to commercialise biotechnology by cloning interferon were, in fact, synonymous with basic research into rDNA procedures. In other words, NBFs blurred the boundaries between pure and applied research to the extent that financial institutions became involved in the support of fundamental research programmes.

That financial institutions, even venture capitalists with their high risk investment profiles, should have become involved in research at such an early stage is extraordinary. As their involvement was to play such a key role in the development of biotechnology, the relationship between financiers and the NBFs will now be considered further.

3.6 Rationales for the New Biotechnology Firms: the Scientific Perspective.

It becomes apparent that NBFs were formed and supported for a number of reasons other than those relating to the commercial development of a new technology. There were other rationales, perhaps not immediately obvious, which were satisfied by the formation of these firms. For academic entrepreneurs, at least some of the following reasons apply.

3.6.1 Legitimizing rDNA research.

Section 3.4 of this Chapter showed how, during the rDNA debate, scientists began to emphasis the societal (and commercial) benefits of rDNA research. The example of interferon was a particularly useful one with which to illustrate the opportunity costs of any restraint or inhibition of rDNA research (although it was not, of course, the only example used). Any delay in research would delay progress towards manufacturing this and other useful products. Seen in these terms, the formation of NBFs represents a logical culmination in the process of legitimizing rDNA research.

3.6.2 Satisfying entrepreneurial desires.

Along with justifying their research, emphasis on these commercial aspects alerted scientists to the rewards which might accrue from the successful exploitation of their research. Molecular biologists could become academic entrepreneurs, just as their colleagues in the physical sciences were in electronics and computing. Moreover, not only could there be the tangible financial benefits, there were also the less tangible rewards of being associated with a glamorous new high technology industry which promised so much.

3.6.3 New biotechnology firms as research units.

As well as being entrepreneurial, commercial ventures, NBFs were also basic research establishments. Indeed, in some instances finance was sought from commercial sources to fund research programmes from which federal support had been withdrawn.

Research into the cloning of insulin and interferon answered basic research questions too, such as how gene expression is regulated. In addition, investment in interferon was an attractive proposition: it was unlikely that a more mundane, less glamorous product would have attracted so much investment. As Fisher writes:

> 'Many of the early companies received funding based on their work on interferon. There was a high level of interest among investors in the ability to produce those proteins in quantity through genetically engineered microorganisms. Overall, perhaps as much as 25% or more of the money raised to date [1983] has been targeted for exploration of the possible therapeutic effects of these proteins' (Fisher, 1983:15).

3.7 Rationales for the New Biotechnology Firms: the Investor's Perspective.

Aside from the general investment climate in the US - namely, that venture capital was readily available, academic entrepreneurship much more readily accepted and the other factors described in section 3 of this Chapter - we may account for investment in NBFs on the following grounds.

3.7.1 The rDNA debate and the interferon 'hype'.

As has been shown in previous sections, both the rDNA debate and the interferon 'hype' in the US contributed to an investment climate favourable to the funding of NBFs. The intensity of the rDNA debate in the US raised the consciousness of investors as to the possibilities of genetic engineering. Certainly, when a European-based NBF, Biogen, attempted to raise finance in Europe in 1978, it failed and had to turn to North America for funding. Furthermore, involvement in interferon could be seen as glamorous and worthwhile, almost altruistic. In support of this, Panem (1984:27) cites a scientist involved in promulgating interest in interferon and an investment analyst, both of whom consider that the ability of NBFs to secure venture capital funding was intimately associated with their decision to clone interferon. Again, we might question whether venture capitalists would have been prepared to make funding available for less spectacular or less high-profile products.

3.7.2 Market projections for biotechnology product sales.

A technology assessment programme, developed at the NBF Genex in 1980, speculated that total annual sales of 500 different products would amount to $40 billion by the year 2000. The corporate investment required to achieve these sales would amount to $24 billion. Income on all 500 products would amount to $3.5 billion, representing a return on investment of 15% (Glick, 1986).

Again in 1980, it was estimated that a successful interferon preparation could command worldwide sales in excess of $2 billion (Schwartz, 1980). The profits for a company with a cheap production process could, on these projections, dwarf those made from tranquillizers (Wright, 1980).

3.7.3 Interpreting the risks of funding new biotechnology firms.

It may well be that venture capitalists were unable to do anything other than invest in biotechnology. Given the general atmosphere which prevailed at the time - the effectiveness of the molecular biologists' lobby in repealing the rDNA moratorium, the success of the medical sciences in obtaining publicity and funding for interferon research, the projected sales for interferon and other biotechnology products - it seems reasonable to suggest that it would have been ridiculous not to have had a stake in an NBF. The risks of losing a stake in a failed company were far out-weighed by the risk of losing out on the reward should it be able to develop a successful interferon production process.

Another explanation is that venture capitalists, in their eagerness to make investments in biotechnology, relaxed their investment criteria. Bullock states that:

> 'Many (venture capital) firms state that their technical assessments of the products are perfunctory, because the key factors are an understanding of the market and above all a correct assessment of the people.' (Bullock, 1983:23, emphasis added)

The factors shaping the motivations of "the people" - the scientists - have already been outlined above. Yet it was the

scientists who had both created the climate that led to venture capital interest in biotechnology, and who were being assessed by the venture capitalists. This being so, why should venture capitalists have been so eager to put their money into NBFs?

3.8 Science and the Media.

One of the themes running through accounts of the rDNA debate and the interferon episode is just how eagerly some members of the scientific community sought out the media in order to promote their research interests. (It should also be noted that, when it suited, information was confined to within the scientific community, in order to avoid unwelcome public attention.) Few members of the public (including the investment community) have access directly to scientific information networks (conferences, journals and so forth). Instead, public images of science are obtained primarily from information provided by the media, mainly the newspapers, television and radio. Here, the media face two problems. In order to be able to communicate with a largely technically illiterate audience, scientific and technical information has to be simplified, often losing in the process the meaning and context of the information (McCormick, 1984). As was stated earlier (in section 4 of this Chapter), scientific "maybes" have the habit of becoming public "definitelys".

Although scientists may deplore this misrepresentation, it is equally true that the media can be used by the scientific community for its own purposes. This happened throughout the rDNA debate. Experiments with little real relevance to safety issues were announced to the press prior to publication, their significance grossly over-stated (Wade, 1986). Similarly, the announcement in January 1980 that the NBF Biogen had cloned interferon was made, not in the usual way in the scientific press, but at a press conference before publication of the work. This was arranged by one of Biogen's backers, Schering-Plough, whose stock was boosted on the New York stock exchange as a result, even though no marketable product could have been available for several years (Fox, 1980). Commenting on this, Andreopoulos (1980) claimed that both Biogen and another NBF, Genentech, made such

unauthenticated claims in carefully arranged bids to raise confidence, in Genentech's case prior to public flotation.

3.9 The 'New' Biotechnology Industry in America.

It becomes apparent that, early on at least, investment in US NBFs was based on poor information generated in a highly charged investment climate, information which was frequently insubstantial. Certainly, there is no evidence of any technology development strategy at work. But whilst the basis on which many of these investments were made often appears to have been questionable, the effect was to put the US at the forefront of developing biotechnology. This is almost certainly due to the sheer volume of money poured into NBFs as a result of the investment 'hype' rather than any intrinsic efficiency or superiority of the market in 'picking winners'. Nevertheless, some of the effects of the establishment of NBFs will now be described.

3.9.1 Relationships between established companies and NBFs.

The emergence of NBFs radically altered the structure of America's bioscience-based industries. Freeman (1982) points out that, because of high development costs, small firms have historically played only a minor role in pharmaceutical innovation. For example, in 1976 the US pharmaceutical industry was characterised by a number of research based, integrated, multinational corporations. By 1984, evidence of the extent to which rDNA and monoclonal antibody technology lowered barriers to product development is that of 135 US companies pursuing pharmaceutical production and process development in biotechnology, 58 were established companies and 78 were NBFs. Similarly, in animal agriculture, 27 established and 34 NBFs were involved in biotechnology-related R&D. For plant agriculture, the figures were 22 and 30 respectively (OTA, 1984:67-82).

In fact, most established companies did not start in-house biotechnology research and development until 1981 or later. Initially, NBFs fulfilled this role by providing established US and foreign companies with research services for specific products. In this way, and by concluding licensing agreements,

NBFs were able to finance their internal R&D programmes. The role of large firms was in innovation, that is in obtaining product registration and manufacturing and marketing products, all of which continued to present considerable obstacles to NBFs. Table 3.4 below shows the extent of equity investments in NBFs by established companies.

Table 3.4 Equity investment in US NBFs by established companies, 1977-1986.

Year	Amount ($ million)
1977	2.00
1978	32.25
1979	22.25
1980	77.91
1981	78.20
1982	119.30
1983	40.00

Source: Office of Technology Assessment, (OTA, 1984), p.101.

3.9.2 Other research agreements.

The money being attracted by NBFs reflected the strength of America's basic research capabilities in biotechnology. At the same time, American universities were receiving indications that Federal support of basic molecular biology research would not expand at a rate sufficient to meet demand. As a result, a series of high profile university-industry partnerships were concluded in the early 1980s as established companies sought to gain a 'window' on the latest basic research programmes. The first of these agreements, between Massachusetts General Hospital and the German pharmaceutical and chemicals company Hoechst A.G., was concluded in April 1980. Scheduled to run for 10 years, until October 1990, Hoechst provided $67.3 million to create a new Department of Molecular Biology within the hospital. The deal gave Hoechst first right of refusal on any discoveries with commercial potential, but did not specify any particular research programme. Other agreements followed including, in 1981, a 3 year deal worth $3.88 million between Washington University and Mallinckrodt Inc. for hybridoma research and, the following year, a 5 year deal between

Monsanto Biomedical Research and Washington University worth $23.5 million (Reams, 1986).

3.9.3 Finance aspects of US new biotechnology firms.

The interest and hyperbole surrounding NBFs culminated in 1980 and 1981 when a number of NBFs began to seek stock market quotations to raise additional funding. Genentech's market debut in October 1980 was one of the most spectacular on record. Priced initially at $35 a share, the share price rose at one point to $89, falling back to $71 at the end of the first day of trading. The valuation of the company at this point was $500 million, although its revenues in the issuing prospectus were a mere $3.8 million - almost all of this from contract research - and earnings totalled only $80,000 (Dickson, 1980). Within a few months, the shares were being traded at near their original offer price.

The public flotation of Cetus in March of the following year was made with the market in a more sober mood. The shares opened at $23 and stayed within a few cents of this price all day. Nevertheless this represented, at $119 million, the largest initial public stock offering for a new company on Wall Street (Dickson, 1981).

The extent of investor interest can also be measured in that, in 1981, Genentech's shares were trading at 695 time earnings, whilst those of Cetus were trading at 440 times earnings. In contrast, those of an established pharmaceutical firm, Merck, were trading at 16 times earnings. This indicates that the stocks of both NBFs were hugely over-priced as a result of investor expectations of future returns on their investment (Sloan, 1982).

The following year saw the first casualties amongst the NBFs. In May, a company which had been involved in producing interferon, Southern Biotech, filed for bankruptcy just 9 months after a public stock offering had raised $4 million (Norman & Marshall, 1982). August saw a second NBF with interests in agricultural biotechnology, Armos, go bankrupt. Non-renewal of a collaborative research agreement with Standard Oil of California, for a project dealing with the production of high-purity fructose, led to 40

employees of Cetus being laid off (Shapley, 1982). Although the following year saw a peak in the price of biotechnology stocks, by 1984 such investments were being viewed more cautiously. Stocks in a number of firms (including Biogen, one of the earliest NBFs) were trading well below their offer price. Venture capital funding became more difficult to obtain as venture capitalists began to realise that biotechnology was not like the semiconductor industry, that returns were considerably more distant.

These casualties were only to be expected, and interest in the financial characteristics of NBFs continued unabated. In August 1982 the Nature Biotechnology Index, a weighted index of the listed stocks of 15 US NBFs, began to be published (anon., 1982). This was published until December 1984, reappearing the following year in a modified form in Nature's sister journal Bio/Technology.

This increased coverage of business affairs in the scientific press is but one more reflection of how, in biotechnology, many areas of applied commercial research are at the same time fundamental basic research. It is also an indication of just how radically the way in which biological scientists perceive the nature of their work has changed in recent years. Until quite recently, many academic scientists saw basic university research as a separate, intellectually superior exercise to that of applied industrial research, about which they were often openly disparaging (Hale (1971) provides a useful contemporary account of these attitudes). Today, this attitude of academic eliteness is all but a thing of the past. Of course, this has much to do with restrictions on funding for basic research and the need to find alternative sources of income. Furthermore, many of the fundamental breakthroughs in gene manipulation technology have emerged from commercial laboratories who have the resources, both manpower and financial, with which academic research is unable to compete. Nevertheless, the recognition both that academic research has a commercial dimension, and that industrial research is not a pastime for failed academics, represents a considerable shift in attitudes. The emergence of commercial biotechnology has played a catalytic role in the formation of this new perception.

3.10 Developing Policies for the Exploitation of Biotechnology in Britain.

In response to the lead set by America in developing biotechnology-based industries, other countries began to focus their attention on how to best exploit their indigenous biotechnology capabilities and resources. Unlike the US, where biotechnology emerged in the absence of any explicit policy framework, these efforts were characterised by the proliferation of documents outlining programmes to develop these capabilities (OTA, 1984:503).

The British perspective was one of a nation second only to the US in the strength and depth of its basic research capabilities in the biosciences. However, in contrast to the American situation, there was little evidence that full advantage was being taken of this capability. Britain had frequently failed in the past to take advantage of opportunities arising from its scientific expertise: with biotechnology, there again appeared to be a general lack of knowledge and interest from both Government and industry in the commercial possibilities the new techniques offered. This had been brought into focus quite forcibly by the failure of both the Medical Research Council (MRC) and the National Research and Development Corporation (NRDC) to patent the discovery of monoclonal antibodies in 1975, with the result that the initiative for developing them passed to American NBFs. Furthermore, from the mid-1970s onwards the research base itself had been under attack as the result of cutbacks in research funding.

The UK technology transfer problem has been the subject for continuing concern throughout the post-war period. In the late 1970s, the Advisory Council for Applied Research and Development (ACARD) published reports stressing the importance of industrial innovation in improving industrial performance (ACARD, 1978) and the necessity of facilitating innovation in order to survive as a leading trading nation (ACARD, 1979).

In 1979 ACARD, together with the Advisory Board for the Research Councils (ABRC) and the Royal Society (RS), turned its attention to biotechnology, the first specific technology to be so

scrutinized. The terms of reference for the joint working party, chaired by Alfred Spinks, were to review the 'existing and prospective science and technology relevant to industrial opportunities in biotechnology' and identify actions required 'by Government or other bodies to facilitate British industrial development in biotechnology' (ACARD/AERC/RS, 1980).

The findings of the working party, which became known as the Spinks Report, were wide ranging and generally welcomed as the basis for a more coherent approach to the development of Britain's biotechnology capabilities. Among its 24 recommendations, it called for a greater coordination of, and commitment towards, basic and applied academic research, and a more active effort on the part of industry to become aware and take advantage of the opportunities offered by biotechnology. Also, it focussed on mechanisms whereby this awareness could be fostered, in particular through closer collaboration between academia and industry.

Of specific relevance to this thesis was the emphasis the report placed on the technology transfer function performed by small firms. Spinks's view was that such firms had an important role to play in developing biotechnology, but that they faced many constraints and difficulties, in particular in raising finance (ACARD/AERC/RS, 1980:31-32). This led to one of the main recommendations of the report, that the National Enterprise Board (NEB), in conjunction with the NRDC, should catalyze the formation, with public as well as private funding, of a British NBF (ACARD/AERC/RS 1980:41). The purpose of the company was to be two-fold. The first, in having first right of refusal for the exploitation of any developments emerging from MRC laboratories, was its technology transfer role. Second, it was hoped that it would show that such an enterprise could be successful in Britain, providing an example which would stimulate the flow of venture capital into other, wholly privately funded, NBFs.

The Government responded to the Spinks report in the form of a White Paper, published the following year (Cmnd. 8177, 1981). This was dismissive of Spinks's findings. "It was largely unenthusiastic both to Spinks's diagnosis and to his recommendations ... The most careful reading of the White Paper

does not reveal a single clear, unambiguous response to any of Spinks's 24 recommendations" (House of Commons, 1982b:xv-xvi). The White Paper's emphasis was that it was for the private sector to exploit any developments in biotechnology. If the potential was truly as Spinks had outlined it, the market would provide the necessary resources, the Government's role being one of providing a supportive infrastructure within which exploitation could take place. It appeared to be dismissive of any suggestion that Government had any direct role or responsibility in encouraging the development of biotechnology.

In reality, however, the White Paper proved an inaccurate blueprint for subsequent policy developments as the Government's response has been more active than the White Paper appeared to recommend. For example, despite the emphasis placed on the private sector's role in funding any development of biotechnology, the Government did respond to Spinks's suggestion that an NBF be established, by providing half the funding for Celltech, which was formed in 1981. (The importance of Celltech in stimulating the flow of venture capital into British NBFs is discussed further in Chapter six). Indeed, a contract report for the US Office of Technology Assessment commented:

> '[The White Paper] which is supposed to be a statement of government policy is eccentric even by British standards. It took a year to produce, says very little, and does not reflect what the government is doing, their intentions, or the political weight attached to this subject.' (Vaquin, 1982:3)

The range of initiatives undertaken on behalf of the Government by agencies such as the British Technology Group (BTG), the Laboratory of the Government Chemist and the Department of Trade and Industry (DTI) (Deitz, 1984), means that the UK's commitment to biotechnology now "compares favourably with those of other industrialised countries" (Rothman and Towalski, 1984:48). More recently, Sharp (1987:291) has observed that, although no 'strong, central coordination of effort on the part of the British Government' has emerged, a combination of Research Council initiatives, BTG investments, DTI selective assistance for biotechnology and the stimulus of private venture capital markets

'adds up to a programme which begins to have both consistency and coherence'.

This said, the Government's overall response to Spinks's recommendations and its commitment to developing Britain's biotechnology capabilities has been ambiguous in a number of respects. It was involved in setting up Celltech. Its commitment to private enterprise and small firm growth has been responsible for the wider availability of venture capital funds. But in contrast, rather than acting on Spinks's recommendations to expand research, its actions have had the opposite effect. The cuts in research funding alluded to by Spinks were exacerbated by further extensive - and indiscriminate - cutbacks in 1981-82. These hit science and engineering disciplines disproportionately hard. Evidence presented to the House of Commons Education, Science and Arts Committee by the University Grants Committee in 1982 indicated that 600 engineers (14% of total staff) and 350 biologists (16%) - both disciplines with direct relevance to biotechnology - would be lost as a result of these cuts (House of Commons, 1982a:152).

Attitudes to research funding are critical. NBFs in America arose to exploit fundamental research, and it is widely acknowledged that strength in both basic and applied research is vital to the overall success of any biotechnology development strategy. As the 1982 OECD report on biotechnology notes: 'The ultimate success of biotechnology is dependent on advances in and support for the fundamental sciences which underpin it' (Bull et al. 1982). But in Britain, additional funding that has been made available subsequently for biotechnology research has not made good the 1981 cuts. The Government's attitude is that more funding should come from industry, particularly where commercially-orientated research is concerned (Marsh, 1987). This was made explicit by Roy Dietz who, in charge of the Department of Trade and Industry's Biotechnology Unit, said in 1984:

> '... we believe that only industry has enough knowledge and experience of production and the market to make sound judgements about the direction of industrial development.' (Deitz, 1984:35)

Unfortunately, this attitude does nothing to tackle the cause of Britain's poor record in respect of technology transfer, which has been brought about by a combination of industry failing to make precisely these judgements, and by its failure to invest sufficient resources in research and development. Therefore, in contrast to its competitors, the British Government is alone in not seeing the need to commit substantial additional financial resources to bolster its research capabilities in biotechnology (Sharp, 1987:297). Since in biotechnology, as this Chapter has shown, basic and applied research are frequently one and the same, this could have important repercussions for the development of biotechnology in Britain in the medium to long term.

Indeed, it can be argued that Britain has no biotechnology policy or strategy as such. Although there are initiatives concerned with fostering the development of biotechnology, these are part of a more general industrial and economic development strategy (Williams, 1987) which advocates the role of private sector initiatives and market forces in restructuring industry. This also emphasises the role of small firms in technological innovation. Consequently, the establishment of Celltech and other UK NBFs can more properly be seen as products of this strategy, rather than the result of policy initiatives designed to foster the development of biotechnology in Britain. However, as was pointed out in section 3.9, the establishment of NBFs in the US - which provides much of the impetus for developing NBFs in the UK - has little to do with developing technological capabilities in any planned, coordinated sense. It has worked for the US because of the number of companies supported, which simply reflects the far greater resources available there, rather than any superior efficiency of the market in allocating resources to developing new technology. Therefore, the central role assigned to small firms in technology transfer appears to be overstated for the British case.

In conclusion, the success of the US approach depends on an entirely different economic infrastructure - greater resources, larger markets, higher government spending, different attitudes to entrepreneurship and opportunities for personal wealth accumulation - to that found in the UK. By implication, the extent to which Britain can hope to emulate this market-dictated

technology development strategy, with its emphasis on the role of venture capital-funded new firms, is limited. This is so for two reasons. First, irrespective of the amount Britain spends on research and no matter how successful the Government is in creating an entrepreneurial culture, the major impediment of the small size of Britain's domestic market will remain. In allowing this market to dictate which products are to be commercialised, Britain may well continue to lose out on the economic benefits of commercialising products for which, at present, there is no identifiable market. This leads on to a second more general point made by Rothman and Towalski:

> 'A key element is missing from all the DoI's [Department of Industry's, now the DTI] new technology programmes, and its policy for industry in general. It has no means of making industry invest in new technology or in Britain ... we are arguing that the national policies and programmes for industrial development will fail unless they are part of a national strategy for industrial development which, when necessary, can control and direct industrial and finance capital.' (Rothman and Towalski, 1984:53)

This is not to say, however, that NBFs are inappropriate to Britain's needs. It is the view of the author that they should be seen instead as an adjunct to, rather than a substitute for, a more co-ordinated approach to the commercial development of biotechnology in Britain. To this extent, the co-ordinated approach seen in Japan, Germany and France appears to be more appropriate to Britain's needs.

3.11 Summary.

This Chapter has shown that interest in the commercial potential of biotechnology has been heightened by the activities of new biotechnology firms in America. These firms took a lead role in the early development of biotechnology and have contributed to the current dominance of biotechnology by America. Their formation was possible because of the strength of the entrepreneurial culture in America. However, in contrast to other new technology firms (such as those based on semi-conductors), the formation of, and early interest in, the NBFs was characterised both by the absence of any products and, initially, any evidence that products could be made.

It was shown that this interest can be ascribed to the way in which both scientific and investor expectations were raised as a consequence of the rDNA debate and interest in interferon.

The final section of the Chapter showed how Britain has sought to emulate the American experience of developing new technology by encouraging the establishment of British NBFs. It was shown that this is part of a wider shift in policy which aims to encourage the private sector development of new technology, with Government playing a supportive role - creating an environment which encourages the establishment of NBFs - rather than performing a co-ordinating and overt strategic policy function. Although it has not been possible here to compare the biotechnology development strategies adopted by the UK's competitors, this contrasts with the more active participation of Government in other countries, especially Japan and Germany, where the development of new technology is more a partnership between Government, academia and industry. It is argued that, because of differences between the economic infrastructures of Britain and America, the extent to which biotechnology can be developed in small firms, and the extent to which small firms can be agents of technology transfer, is limited in the British context.

However, this thesis is concerned with aspects of the development of biotechnology in new firms. For this reason, the next Chapter considers the development of policies encouraging the establishment of small firms in Britain and the emergence of venture capital funding in the late 1970s. Chapter five which follows presents a literature survey of venture capital project evaluation procedures, in order to begin to identify how venture capitalists actually deal with technical business propositions.

CHAPTER FOUR

CHANGING ATTITUDES TO SMALL FIRMS IN THE UK AND THE EMERGENCE OF THE VENTURE CAPITAL INDUSTRY IN BRITAIN.

4.1 Introduction.

Following many years of neglect, the 1980s have witnessed a resurgence of interest in small businesses in Britain, in recognition of the important role this sector has to play in the well being of the economy. One manifestation of this renewed interest has been the emergence of a strong, thriving venture capital community. This has made funds available for the establishment and development of small business enterprises on a scale second only to that of the United States. As venture capital-backed small firms are seen as an integral part of developing new technologies, including biotechnology, in Britain, the aim of this Chapter is to examine the underlying factors which account for these recent changes in attitudes.

What makes these events all the more remarkable is that it is only relatively recently that attention has been focussed on the UK small firm sector. A Committee of Inquiry under the chairmanship of John Bolton (usually referred to as the Bolton report), convened to investigate the declining role of the small firm in the economy, was the first comprehensive survey of the sector in the UK (Bolton, 1971). As such, it represents the turning point in interest in the fortunes of small firms and has formed the basis from which subsequent legislative actions have been taken. Bolton's findings were supplemented by the Wilson Committee's Review of the Functioning of Financial Institutions (Wilson, 1980), in particular their interim report on the Financing of Small Firms published in 1979 (Wilson, 1979). These influential reports provide the nucleus for this discussion.

In order to establish the significance of the emergence of the UK venture capital industry, the economic position of small firms and the reason for the sector's relatively poor standing will be discussed. Frequently, it is supposed that small firms may

ameliorate the effects of large scale unemployment. Certainly, this is an important reason why recent attention has been focussed on them. However, it is not the only reason (Rothwell, 1985). Of at least equal importance is that they are seen as a source of new innovative enterprises which perform a seedbed function for the establishment of new large companies and new industries (Bolton, 1971:343). A number of studies have pointed to the importance of small firms in the innovation process (see, for example, studies discussed in OTA, 1984:91-92 which point to the greater innovative capabilities of the small firm). The recognition that small firms performed relatively poorly in Britain and, as a result, were not performing this seedbed function provided much of the impetus for remedial action designed to counteract their decline. For this reason the discussion looks in some depth at the underlying causes of the sector's low standing in order to establish the basis from which ameliorative action was taken.

Having looked in general terms at the environment within which small firms operated, the provision of finance for the sector will be examined. Whilst inadequacies in the availability of short and medium term finance have obvious relevance to the viability of the small firm sector, the discussion focusses on the provision of long term and particularly equity capital in order to illustrate the problems encountered by small firms having cause to seek this form of funding - again, emphasising the major changes in attitude required for the successful development of venture capital.

The term venture capital encompasses a wide range of funding strategies. A strict definition is not therefore available, but broadly speaking the term describes equity participation in new or relatively new ventures which are often innovative in nature, are certainly high risk but offer potential returns far higher than those available from investments in established companies. This return is realised not through dividend yields or interest payments but through capital gains at the sale or flotation of the investee company. Venture capital investments are characterised, therefore, by their illiquidity, with 3 to 7 years a not uncommon holding period. In return the investee company must be able to demonstrate its potential to give the venture capitalist a 40% compound annual return over the period of the investment.

In addition, venture capitalists are often 'proactive' in their relationship with their portfolio companies. Rather than taking a passive or 'reactive' role in a company's affairs (responding only to crises), venture capitalists may be actively involved in the formation of a company (such as recruiting key members of the management team) and in its day-to-day running (for example, by taking a seat on the board of directors of the company and, if necessary, becoming actively involved in managing the company).

It can be seen that, compared with the pure finance role played by other investment institutions, venture capitalism marks a radical departure from traditional financing practices in Britain. The major developments in institutional attitudes and the economic environment necessary to accommodate this change are also described below.

4.2 The Definition of Small Firms.

The nature of small firm activity within the economy as a whole is extremely heterogeneous and, therefore, formulating descriptions of the sector presents certain problems. As a result, no single generally accepted definition of the small firm exists. Table 4.1 below lists definitions of small firms adopted by some member states of the EEC.

Table 4.1 Definitions of small and medium sized firms in eight EEC countries.

Country	Definition
Belgium	1 to 50 employees
Denmark	6 to 50 employees
West Germany	1 to 499 employees
France	6 to 500 employees
Eire	1 to 50 employees (small business)
Italy	1 to 500 employees
Netherlands	1 to 100 employees
United Kingdom	1 to 200 employees (small business)

Source: 'Small Firms in the Economy 1983', CBI Publications, 1983 (CBI, 1983:7).

Qualitatively, small firms are owner managed businesses which exhibit the following three characteristics;

(i) they have a relatively small share of their market,

(ii) they are managed by their owners in a personalised way, and not through a formalised management structure,

(iii) they are independent, in that they are not part of a larger enterprise, and their proprietors are free from outside control in taking their principal decisions (Bolton, 1971:3).

The terms of reference for the Bolton Committee Inquiry gave the broad definition of a small firm as having less than 200 employees. But, as the Committee pointed out, whilst this description might be applicable to firms in the manufacturing sector, in other sectors (for example, retail or construction) such a firm would be large in relation to its competitors. In recognition of this, the attempt to formulate an entirely satisfactory 'quantifiable definition' ended up as a list of, as the Committee admitted '...more or less arbitrary definitions' as shown in table 4.2, which attempted to define the small firm in relation to its industrial sector.

Table 4.2 Bolton Committee Definitions of Small Firms.

Industry	Definition (a)
Manufacturing	200 employees or less
Retailing	turnover £300,000 p.a. or less
Wholesale trades	turnover £1,200,000 p.a. or less
Construction	25 employees or less
Mining/quarrying	25 employees or less
Motor trades	turnover £600,000 p.a. or less
Miscellaneous services	turnover £300,000 p.a. or less
Road transport	5 vehicles or less
Catering	all excluding multiples and brewery managed public houses

(a) turnover at 1982 prices

Source: 'Small Firms in the Economy 1983', CBI Publications, 1983 (CBI, 1983:7).

4.3 The Position of the Small Firm in the Economy.

Any account of the relative position of the small firm in the economy is usually prefaced by acknowledging the paucity of reliable historical data which exists on small firm activity, and

the problems of comparing the data that does exist across time, between sectors and internationally. Both the Bolton and Wilson Committees have emphasised this deficiency of available data. With this in mind, the following general comments can be made.

The 1963 Census provided some idea of the scale of small firm activity in the UK. At that time, there were some 820,000 small firms, accounting for 93% of the total number of firms, which employed some 31% of the work force and providing some 20% of GNP (Bolton, 1971:83). In other words, small firms represented a major contribution to the economy. Nevertheless, the Bolton Committee reported that:

> "...up to the middle of the 1960s the contribution of small firms to economic activity was declining in most industries with the exceptions of road transport and some of the miscellaneous service trades". (Bolton, 1971:67)

This trend had also been observed in most other developed countries, with the exception of the USA and Canada, but the process had gone much further in the UK. Although the Wilson Committee Interim Report on Small Firms, reporting in 1979, was able to report that the long term decline noted by Bolton had plateaued:

> "...it still seems to be the case that the small firm's sector in the UK is relatively less important both in terms of output and employment than [in] other developed countries" (Wilson 1979:3).

The decline of small firm's share of total employment and output in UK manufacturing industries to 1975 is shown in table 4.3 overleaf. Table 4.4 which follows shows how this trend started to stabilise in the mid-1970s. Nevertheless, the contribution of small firms to Britain's manufacturing output remained smaller than that of most of its competitors.

Table 4.3 Employment and net output in UK manufacturing 1924-1975.

Date	Employment in UK manufacturing: Small firms as % of total		Net output in UK manufacturing: Small firms as % of total	
	In establishments	In enterprises	In establishments	In enterprises
1924	44		42	
1930	43		40	
1935	44	38	41	35
1948	37		37	
1951	35		32	
1954	33		29	
1958	32	24	28	20
1963	31.6	21.3	27.7	18
1968	31.2	20.8	27.9	18.1
1970	27.9	21.3	25.0	18.5
1971	27.9	21.0	25.0	17.9
1972	27.4	21.5	24.2	18.4
1973	27.4	20.7	24.0	17.1
1975	28.9		25.2	

Sources: 'Committee of Inquiry on Small Firms' (the Bolton Report), tables 5.1 and 5.2, and 'The Financing of Small Firms: Interim Report of the Committee to Review the Functioning of Financial Institutions', tables 2.2 and 2.3 (Bolton, 1971:58-59; Wilson, 1979:45-46).

NB - the Bolton Committee used the terms 'firm' and 'enterprise' synonymously, meaning a unit with ultimate control over a business. This is distinct from an 'establishment', which is generally a reporting unit, such as a factory or plant. Thus an enterprise can consist of one or more establishments under common ownership.

Table 4.4 Employment and net output in small firms, 1975-1980.

	Employment in small enterprises	Net output in small enterprises
1975	21.9	18.0
1976	22.6	18.2
1977	22.5	18.7
1978	22.8	19.3
1979	23.1	19.5
1980	24.3	21.5

Source: Derived from Curran, J. and Stanworth, J., 'Small Business Research in Britain' (Curran and Stanworth, 1984:148).

(NB - All figures based on establishment, not enterprise, figures)

4.4 Reasons for the Decline of the Small Firm Sector.

It is apparent from table 4.3 that, in terms of its contribution to the UK economy, the small firm sector was in a state of long term decline, and that this trend had accelerated markedly in the post war years up to the 1970s. The reasons behind this decline are multifarious. However, they relate to, and must be seen in terms of, more widespread changes in Britain's economic and industrial infrastructure over this time. For example, transport developments made local markets national ones, exposing small local firms to powerful outside competition. Likewise, small firms were unable to avail themselves of considerable economies of scale in marketing. Most notably, the years since World War 11 had seen a concentration of industrial activity in the large firm sector and the increasing dominance of industrial investment by the financial institutions (Bolton, 1971:75-81).

Before considering the effects of these changes on the small firm sector, the changing economic status of Britain will be considered. It is against this backdrop that the poor performance of small firms must be measured, making their decline even more marked.

4.4.1 The decline of the UK economy.

Throughout the 20th Century, Britain's economy had been expanding more slowly relative to that of its competitors. As can be seen from table 4.5 on the next page, this decline increased in the post war years and, as a result, Britain's standard of living fell well below the average of its competitors.

Table 4.5 Rate of growth in major developed countries and GDP per head in major developed countries, 1958-1978.

	Rate of growth (% per year) of gross domestic product in purchasers' values at constant 1975 prices.			Gross domestic product per head, in US dollars at 1978 current prices and exchange rates.	
	1958 -68	1968 -78	1958 -78	1960	1978
UK	3.3	2.2	2.8	1,350	5,550
USA	4.4	2.9	3.7	2,800	9,650
Japan	11.0	6.6	8.8	450	8,500
France	5.3	4.4	4.9	1,300	8,850
Germany	4.9	3.5	4.2	1,300	10,400
Italy	5.9	3.4	4.6	750	4,600
Sweden	4.5	2.1	3.3	1,850	10,550
EEC	4.5(1)	3.5	3.9(2)	1,150	7,600
OECD	5.1(1)	3.7	4.3(2)	1,450	7,800

(1) - 1960-68
(2) - 1960-78

Source: Committee to Review the Functioning of Financial Institutions, 1980 (Wilson, 1980:129).

Why did Britain's performance compare so unfavourably with its international competitors? Part of the explanation lies in changing patterns of trade, as the UK turned away from its traditional trading partners of Empire and Commonwealth and became increasingly integrated into the world economy. As such, what could previously be considered as relatively closed trading arrangements became more open to international competition, the result being that an influx of foreign manufactured goods decreased company profit margins. Further, the economy became more susceptible to fluctuations in commodity prices, and was particularly affected by the tripling in oil prices following the 1973 Middle East War. However, these problems, together with accelerating rates of inflation and unemployment and high interest rates, were faced by all industrialised economies (Wilson, 1980:15). So whilst these factors undoubtedly contributed to Britain's poor performance, the hostile international economic climate merely exacerbated more deeply rooted problems in the domestic economy.

The explanation for Britain's decline can, therefore, be more properly described in terms of a failure to maintain post-war economic competitiveness. The reasons for this are many and synergistic and as such no overriding factor can be seen to account for Britain's poor performance. Of relevance to this present discussion, there appears to have been a general reluctance to accept the necessity for change as manifest by the attitudes of both management and unions to innovation. The unions seem to have been more concerned with the maintenance of employment in existing heavy industries - such as coal mining and shipbuilding - and the advantages of technological innovation were effectively nullified through restrictive practices and overmanning. Furthermore, compared to their foreign counterparts, management were less technically qualified and perhaps for this reason less willing to invest in new plant and machinery. This failure to innovate, to develop and adopt new production methods, coupled with numerous other shortcomings - poor industrial relations, failure to market products effectively, insular attitudes - all combined to reduce company profitability and industry's position relative to foreign competitors. This in turn made investment in industry a less attractive proposition. However, without this investment Britain had no hope of competing effectively in world markets. Consequently, the Wilson Committee took the view that prominent among the reasons for Britain's decline was:

> "...the relatively low level of real investment in this country, particularly in manufacturing, and the poor effectiveness with which new investment is used." (Wilson, 1980:19).

These factors, together with the lack of any stable industrial policy from Government, contributed to making Britain a less favourable environment for industry than most other developed countries.

4.4.2 Industrial concentration.

The emergence of the large company and its relative contribution to the UK's economy is one of the most pronounced changes in Britain's post war industrial structure. Between 1949 and 1976,

the share of the 100 largest firms in manufacturing output almost doubled from 22% to 42% (Utton, 1984:1). Whilst this process had also been seen in other industrialised countries, in form and extent industrial concentration was a much more significant feature of the UK economy. It was also one which had many adverse implications for the small firm sector.

The high proportion of large firms which existed in the 1960s was often interpreted as a sign of an advanced economy. The rationale was that further concentration and rationalisation, through mergers and takeover, would produce benefits in terms of greater efficiency (by taking advantage of resulting economies of scale), which in turn would improve industry's international competitiveness. In effect, concentration was seen as being synonymous with modern, effective industry. This attitude was endorsed by Government, which had become more closely involved with restructuring industry throughout the 1960s because of concern over Britain's relatively poor international competitive position. Government involvement in the 'restructuring through concentration' process became formalised through the creation of the Industrial Reorganisation Corporation (IRC) in 1966.

Active between 1967 and 1970, the IRC was charged with the reorganisation and development of firms in strategic industries, the underlying principle being that large firm size could be equated with, and was necessary for, survival and growth. In this way, industry could be revitalised and once again become competitive in world markets. This would be particularly important once Britain had joined the European Economic Community (EEC). The IRC was also a response to a number of mergers in the 1960s which were motivated by purely financial or defensive considerations, which contributed little, if at all, to industrial regeneration.

During the four years of its existence, the IRC was active in the formation of a number of large manufacturing companies, including that of British Leyland, and supported the takeover of Associated Electrical Industries (AEI) and English Electric by the General Electric Company (GEC) (Hague and Wilkinson, 1983).

It is important to note, however, that Britain already had more giant enterprises than other countries in the EEC, and subsequent experience shows, in the UK at least, that concentration has not improved overall profitability and productivity, neither has it increased relatively low levels of industrial investment. Indeed, much of the UK's industrial growth can be accounted for by merger and acquisition rather than by organic growth as is the case in, for example, the US (Samuels and Morrish, 1984:27).

In fact, little of the reason for concentration can be explained in terms of the need for large scale production techniques. Although the share of the 100 largest manufacturing enterprises in manufacturing output roughly doubled between 1930 and 1968, a similar relationship is not shown between manufacturing output and plant size. The percentage of manufacturing output relative to the size of the 100 largest manufacturing plants showed little, if any, change. Although average plant sizes have increased - in absolute terms, their size has more than doubled - the largest firms have increased their activity by building or acquiring more plants or establishments. That is to say, they have not increased their share of output by concentrating in larger units. So, if firms had changed only to the extent that plant size had increased, the share of the 100 largest firms in terms of net output would have stayed around 20% (Utton, 1984:7). It would appear then that:

> "...plant sizes seem to be largely irrelevant to the rise in the concentration of firms, and equally they are not of much help in explaining the acceleration in enterprise-concentration ... [consequently] ... modern production technology offers little by way of explanation of increased concentration." (Prais, 1976:48)

So, whilst it may be true that in certain industries, for example steel production and shipbuilding, greater plant size is required to derive the benefits of efficiency by virtue of large scale production techniques, this is far from being the case in all industries. In most industries where large plants are required to produce economies of scale small firms had, in any case, long ceased to be important. However, in industries where larger plant sizes did not produce plant economies of scale, such as brewing

and baking, the emergence of large firms had a severe deleterious effect on the small business sector with no concomitant economic benefit overall (Bolton, 1971:76).

It is not, therefore, the increasing size of individual plants which accounts for the increase in industrial concentration, it is the rise of the multi-plant firm. One consequence of this is that the concentration of large firm purchasing activities stimulates further concentration, such that large firm dominance in any one sector can erect barriers to entry for smaller firms. Approximately 50% of this can be explained by 'spontaneous drift'; that is, given that a group of firms of all sizes is subject to the same probability of growth and that this growth is unconstrained in any way, this will lead to an increase over time in the degree of concentration in the group (Utton, 1984:11; Prais, 1976:26). To this extent, concentration is inevitable. In practice, however, spontaneous drift is constrained or enhanced by other factors. In the post-war period improvements in, for example, transport and communications have assisted in the development of multi-plant firms, by making the management of widely dispersed plants viable. But as Prais points out:

> "...while (these factors) have indeed played an observable and significant part in the recent general growth of multi plant operations, that part was not a dominant one as far as the growth of giant companies is concerned." (Prais, 1976:75).

Similarly, barriers to entry against the smaller firm presented by the emergence, and increasing costs, of national marketing and advertising presented larger firms with an important advantage and aided concentration. In summary, as the Bolton Committee commented:

> "...there are many powerful forces, some of them apparently irreversible, making for greater industrial concentration and a reduction in the number of small firms." (Bolton, 1971:200).

Of these, the most significant factor working in favour of large firms has been the development of the financial institutions and their increasingly dominant role in industrial investment.

4.4.3 Growth of the financial institutions

The financial institutions had shown sustained growth throughout the post-war years and had become increasingly important in the role they played in industrial investment. Their growth reflected the wider ownership of more modest sums of capital in a developing egalitarian society. This in turn produced changes in the pattern of industrial investment. Prior to 1939, the majority of industrial securities were held by private individuals. However, the wider distribution of capital in the post-war period, coupled with increased levels of personal taxation, combined to decrease the attraction of holding securities directly, and increased the requirement for personal risk aversion and liquidity. Consequently, savings were increasingly channelled into the financial institutions. Over time, this changed the pattern of industrial investment from direct holding of securities to indirect holdings through intermediaries (Clarke, 1979).

Whilst the clearing banks and building societies had shown the most pronounced growth over this period, these institutions place only a small part of their funds in long term securities. For this reason the Wilson Committee felt that the relatively smaller expansion of the pension funds and insurance company sector was more important, because they placed the majority of their funds in this way (Wilson, 1980:92). The tax advantages associated with savings placed in these institutions and the wider provision of occupational pension schemes had resulted in a large and growing cash flow into the pension and life funds, funds which had to be reinvested. They had as a result become the main purchasers of both government stock and company shares (Wilson, 1980:19). It was this growing institutional dominance of shareholding and the implications of this dominance which were one of the major themes of the Wilson Report.

This is reflected in the fact that in 1957 the institutions held 21% of listed UK ordinary shares against almost 50% by the end of 1978. They also provided just under half the listed UK company loan capital, three quarters of listed UK company preference shares and two thirds of listed public sector securities. In contrast the personal ownership of shares had decreased from 66%

in 1957 to about 32% in 1978 (Wilson, 1980:72). The distribution of shareholdings is displayed in more detail in table 4.6 below.

Table 4.6 Distribution of shareholdings, 1963-1981.

(a) Percentage distribution between persons, financial institutions and others.

	1963	1969	1975	1981
Persons	54.0	47.4	37.5	28.2
Financial institutions	30.3	35.9	48.0	57.9
Others	15.7	16.7	14.5	13.9

(b) Percentage distribution between major classes of financial institutions.

	1963	1969	1975	1981
Insurance companies	10.0	12.2	15.9	20.5
Pension funds	6.4	9.0	16.8	26.7
Unit trusts	1.3	2.9	4.1	3.6
Investment trusts and other financial institutions	11.3	10.1	10.5	6.8

Source: Stock Exchange Survey of Share Ownership, presented in Davis and Pointon, 'Finance and the Firm', 1984, figs. 21.1 and 21.2, pp.238-239 (Davis and Pointon, 1984).

Given this dominant position it is perhaps not surprising that the perceived failure of the city institutions in providing industrial finance was seen as one of the main reasons for Britain's post-war decline. The Wilson Committee's remit was to investigate the relationship between the institutions and industry to see if this was indeed the case. Although the Committee found it difficult to come to any firm conclusions, its findings tend to indicate a degree of risk aversion in the investment behaviour of the institutions. Of principal relevance to this discussion is the failure in meeting the demands of small and particularly new businesses and in the failure to support high risk ventures especially where a lengthy payback period was expected (Wilson, 1980:257).

In theory, the institutions should have been able to spread the risk of individual investments through holding diversified portfolios. In practice, however, because of their fiduciary

responsibilities the proportion of investments they made in small, comparatively high risk enterprises was very small with funds being channelled into larger, less risky - but lower potential return - enterprises. Even so, it would appear that the financial institutions interpreted their fiduciary responsibilities too narrowly. Indeed, the Wilson Committee questioned the extent to which pension funds and insurance companies contributed to real investment, since rather than investing in the creation of future real resources a high proportion of their funds were used to purchase existing financial assets (Wilson, 1980:259).

So, whilst it should be remembered that, owing to the poor returns from industry as a whole, lack of investment extended to the large firm sector as well, the emphasis on investment in the large firm sector can be seen as a major contributory factor in the decline of the small firm sector through acting in favour of industrial concentration and causing shortage of funds for small businesses.

In summary, the combination of a generally poor economic environment, the dominance of industry by large companies and the dominance of financial institutions in industrial investment all acted against the small firm sector. Indeed, in identifying the transition to a more fully employed post-war economy and the concurrent general increase in living standards as two factors which generally assisted the small firm sector, the Bolton Committee commented:

> "...we have found it extremely difficult to identify any factors working strongly in favour of the small firm." (Bolton, 1971:75).

4.5 The Provision of Long Term Finance for Small Firms.

The preceding discussion indicates that small firms were relatively disadvantaged in a number of ways when compared to large firms. In this section the problems of obtaining finance will be examined more closely.

Whilst the adequacy of short and medium term finance has important implications for the development of new businesses, considerations of these are secondary to the provision of long term, particularly

equity, participation in small firm development. An examination of the historical availability of long term funding is important in establishing the prevailing attitudes in which venture capital emerged in the late 1970s. Therefore, this section will focus on the availability of long term equity finance and venture capital, first by looking at the institutions involved in providing this finance, and second at how successful they were in meeting the needs of the small firm sector.

4.5.1 The development of long term finance for small firms

Industry in the UK had not, historically, had to look to the financial system to obtain finance for growth. The Industrial Revolution in Britain had been funded largely by private individuals and patronage, with the banking system developing from the wealth that industry accrued. This formed ingrained attitudes: on the one hand, British industrialists were jealous of their independence and reluctant to relinquish equity in their firms; on the other, financiers were not as familiar with industries needs as they might have been. In contrast, amongst Britain's competitors much closer relationships existed between industry and the banks. In Germany, for example, the banking system was created in order to finance industrialisation, not as a consequence of it (MacMillan, 1931:162).

That said, the problem of raising long term finance in the form of equity capital was a long standing one both in the UK and abroad. From the end of World War One, technical size was increasing the optimum size of manufacturing units. Increased size conferred benefits, such as discount on the bulk purchase of raw materials. Therefore, additional funding was required for both technical efficiency and competitive advantage. Trends had also begun towards increased taxation, less disposable private wealth and greater institutional saving (Thomas, 1978:116-117)

That a problem existed in obtaining this funding in Britain was first identified by the MacMillan Committee on Finance and Industry in 1931. The MacMillan Report noted the difficulties encountered by small and medium sized companies wishing to raise up to £200,000 (in excess of £2 million in today's terms), sums

which, however, were not sufficiently large to justify the expense of a public share issue (MacMillan, 1931:173-174). The MacMillan Committee suggested that this need - the Macmillan Gap, as it became known - could be met through the formation of an investment company concerned solely with providing equity and loan finance to small businesses.

In response to this, a number of specialist investment houses were set up in the 1930s. The most significant were the Charterhouse Industrial Development Company Limited and Credit for Industry (both 1934) and Leadenhall Securities Incorporation (1935). Others included the New Trading Company, the Industrial Finance and Investment Corporation, Lonsdale Investment Trust, Northern Territories Trust, Private Enterprises Investment and the Glasgow Industrial Finance Company. These, together with some stockbrokers and several merchant banks had combined resources of perhaps £1 million (Thomas, 1978:119-121).

Charterhouse was conceived as a nursery for small promising companies, providing finance until the firm was in a position to make a public share issue (Bates, 1971:103). As such, it was:

> "...the first modern professionally managed specialist fund, providing risk equity finance for young and growing small businesses in the United Kingdom." (Lorenz, 1985:17)

Although these funds would now more properly be described as development capital funds, their foundation in effect marks the beginning of venture capitalism in the UK. However, these and a number of other smaller, more specialised, financing institutions and issuing houses could meet only a tiny proportion of the pre-war demand for this type of finance.

In recognition of the much greater resources that would be required for post-war reconstruction, 1945 saw the establishment of the Industrial and Commercial Finance Company (ICFC). Initially supported by £45 million from the main clearing and Scottish banks, with additional backing from the Bank of England, ICFC provided long term loans and equity capital in the region of £5,000 to £20,000. It became at once, and remains, the largest

institutional provider of this type of finance. Indeed, for many years ICFC was the only organised source of this type of funding in the UK. In 1984 under its new name, Investors in Industry (3i) it accounted for some 65% of all venture capital in the UK (Cary, 1985:48). When the Radcliffe Committee on the Working of the Monetary System reported in 1959, it was satisfied that the Corporation had, by and large, been effective in meeting the demand described by MacMillan (Radcliffe, 1959:325-328).

In the decade after the Radcliffe report the number of firms providing finance for small firms grew rapidly. An increased awareness of the attractions of the private company sector, particularly high technology companies - reflecting interest aroused by the success of small firms in the American electronics industry - led to a "mini-boom" in British venture capital. The branch system of ICFC was expanded, a number of new venture/development capital companies emerged, London based merchant banks expanded into the provinces and a number of local merchant banks and clearing houses emerged (Holborn and Edwards, 1971). Although there was subsequently to be considerable retrenchment in the face of a credit squeeze and the onset of a recessionery environment in the early 1970s, at the time of the Bolton report the facilities available for the small firm wishing to raise external funding had expanded considerably. But how successful were they in meeting the needs of small firms?

4.5.2 The adequacy of long term finance for small firms.

The Bolton Inquiry found that, generally speaking, external funds formed a relatively small proportion of total assets employed in the small firm sector, with internally generated funds being far more important. Only in fast growing companies did recourse to external funding become significant. However, the institutions were charged that, for firms which did look to external sources, the availability of funds was constrained. In particular, providers of long term finance were criticised for adopting unrealistic standards of creditworthiness for small firms and that the rates they were required to charge for long term funding were beyond the means of most small firms. For example, ICFC had attracted a great deal of criticism for adopting standards that

were too rigorous. However, the Corporation was in business to make a profit and needed to invest in creditworthy firms. As Bates points out:

> "It is reasonable to adopt normal standards (in small company investment) and most institutions have to take a prudent if far-sighted view, but one of the problems of small firms is that they frequently cannot fulfil normal standards: they may not have a good profit record, they may appear risky, their plans may take a long time to mature." (Bates, 1971:106).

Indeed, the institutions could respond that:

> "...creditworthy firms can always find finance provided that the project for which the capital is required is a sound one." (Bolton, 1971:156).

Bolton's findings tend to support the institution's view - the committee could find no evidence for the existence of:

> "...the small firm which needs finance, deserves it, has made serious efforts to raise it and has been turned down." (Bolton, 1971:189)

It would, however, be untrue to say that small firms were not disadvantaged in obtaining external funding. As has been previously noted in section 4.4.3, the insurance companies and pension funds had become the largest source of long term industrial finance. The terms and conditions on which they invested reflected their preference for investment in quoted companies. Consequently, few small firms could meet their criteria and the institutions were little involved in small company funding.

It must be remembered that the problem of small firm finance dates back to the MacMillan Gap of 1931 - when private investors dominated industrial investment. It would be unreasonable, therefore, to suggest that the finance institutions were overtly antipathetic to the needs of small firms, but rather the increased institutionalisation of funds merely exacerbated existing adverse conditions experienced by small firms in raising long term funding. Notwithstanding the risk averse attitude of the institutions described in section 4.4.3, these adverse conditions

can be explained in terms of the cost of scale bias favouring large scale share purchase and the lack of a market for small firm equities.

The cost of scale bias manifests itself in two ways. First, there are the costs associated with issuing share capital. These may be summarised as:

(i) the costs of underwriting the issue - which, because of the higher risks involved in small issues, are proportionately larger for small issues to compensate for this risk element,
(ii) a quotation fee,
(iii) fees payable to advisors, brokers and lawyers to the issue,
(iv) costs associated with issuing a prospectus for the issue,
(v) the costs of processing applications and of share allotment.

These costs reduce in proportion with increases in the amount of equity being sought. For example, over the period 1959 to 1971 - roughly the period between the Bolton and Radcliffe reports - issues of capital below £500,000 cost nearly 10% of the share issue, whereas with one exception issues of over £1 million cost less than 5% (Davis and Yeomans, 1973:17-20)

Secondly, this cost of scale effect reflects in part the greater difficulties in assessing the potential returns from small company investments. It is easier to demonstrate this potential for larger companies where information is more accessible and the company has an established track record. Also, the growth of the Stock Exchange and the consequent institutionalisation and regulation of share trading decreased the risk and increased the liquidity of investing in quoted securities. It became possible to trade large blocks of shares without substantially affecting a company's share price and consequently the value of any retained holdings (Samuels, 1984:72-73). For these reasons, few institutions made investments in companies valued at less than £5 million, most preferring companies with a market capitalisation of £50 million or more (Wilson, 1979:13).

In contrast, investment in the securities of unquoted companies, where no ready market for shares existed, meant committing capital

for long periods of time with no guarantee that the investment would be recouped. In comparison with investment in quoted companies such investments were, therefore, highly speculative and not an attractive proposition for the institutions.

In summary, the Bolton Committee considered that:

> "...there was no institutional deficiency in the financial market, that while there are some differences in the bases on which small firms and large can raise money these are mostly functions of inherent cost and scale differences...the role of the institutions, however adaptable and sensitive to market needs they are, is necessarily limited; if the small firm sector is to be preserved, institutional finance can never take the place of personal wealth and ploughed-back profits." (Bolton, 1971:154).

By 1979 however, the Wilson Committee commented:

> "...there can be little doubt...that there are deficiencies in the availability of equity finance for small businesses and that this is putting undesirable constraints on their rate of creation and growth." (Wilson, 1979:9).

and that this applied to both start-up companies and those companies seeking development or expansion finance, particularly fast growing companies. For example, Wilson noted that the ICFC financed few actual start-ups, and that other development capital companies:

> "...are frank about their lack of interest in start-ups because of the additional costs and risks involved." (Wilson, 1979:9)

In addition, it was felt that:

> "...making more equity finance available for start-ups might result in an increase in the number of weak, ill-prepared and misconceived projects put forward. It is sometimes argued that the more successful new ventures are those which are started within the limitations of what their founders can invest." (Wilson, 1979:10).

Wilson discounted this, arguing that lack of finance was in fact a handicap to small company creation and expansion. In any case, since the Bolton Report, high rates of inflation and high interest rates, exacerbated by the oil crisis of 1974 and subsequent recession, had made financing expansion and development through retained earnings or loans more difficult and had increased the need for external finance, particularly equity participation.

4.5.3 The changing attitudes in policy towards small firms.

The contradiction in the observations of the Bolton and Wilson Reports can however only be partly explained in terms of the effects of the recessionary environment of the 1970s and its direct impact on small firms. If anything there were more sources of finance available to small firms in 1979 than there had been in 1970, represented in particular through the activities of the newly created Scottish and Welsh Development Agencies and the then emerging UK venture capital industry. Rather, Wilson's comments can be more properly ascribed to the increased importance attached by Government to the role of small firms in employment creation and the technological redevelopment of industry in the face of the continued contraction of Britain's manufacturing base. One exemplar of this was Wilson's recommendation that measures should be introduced to encourage the formation of Small Firm Investment Companies which would make good this perceived financing gap (Wilson, 1979:41). The measure was not subsequently taken up in practice, although the idea was included in the 1983 and 1987 Labour Party election manifestos. Instead, the need has been met to a large degree by the expansion of private sector venture capital.

The contradictory findings of the Bolton and Wilson Reports is important in understanding how venture capital came about. The Bolton Committee found:

> "...that many small firms believed themselves to be operating in a generally hostile environment as a result of the actions of Government." (Bolton, 1971:92).

which manifested itself as:

> "...a long term and irreversible decline in the small businessman's ability to control his environment; a sense of persecution caused by the detrimental side effects, deliberate or not, of the activities of Government; and frustration at the delays and impediments arising from the sheer multiplicity of official regulations and requirements." (Bolton, 1979:97)

The reason for this was readily identifiable:

> "Notwithstanding the fervent beliefs of so many of our witnesses, we have found no evidence of deliberate and consistent discrimination against small firms by Government departments. In our view it is simply untrue to say that Government policies have been aimed at the supression of the small firm sector...The most telling criticism of Government in this field is not that its policy towards small business is misconceived or hostile, but that it has no policy. As far as we can ascertain, this has always been the case; it is not a recent development." (Bolton, 1971:95, emphasis added).

This comment encapsulates the rationale behind the major recommendation of the Bolton Committee. They felt that the problems of the small business sector existed largely because, unlike many of the UK's overseas competitors, there was no central administrative division within Government specifically responsible for looking after the interests of small business. In order to rectify this situation it recommended the establishment of a Small Firms Division within the Department of Trade and Industry to co-ordinate and implement policy for the small firm sector, with a Minister of the DTI being designated as responsible for small business affairs (Bolton, 1971:104).

The importance of Bolton is not so much for this and other legislative changes that emerged directly as a result of its findings - it had in any case rejected the argument for any discriminatory legislation favouring small firms. Rather, it placed small firms on the political agenda for the first time. In doing so, it paved the way for an increasingly hands-on and interventionist approach in dealings with the small firm sector throughout the 1970s. This culminated in the Conservative administration of 1979 introducing legislation which, whilst not overtly discriminatory in nature, for the first time directly

assisted in the formation of small firms (Beesley and Wilson, 1984:Chapter 9). According to the Department of Trade and Industry, 98 measures had been introduced by 1983 which were designed specifically to assist small firms, with more having been added subsequently (Curran, 1986). It is the cumulative effects of this changing policy emphasis which created the environment within which the venture capital industry could develop and flourish.

4.6 Finance for High Technology Companies in Britain.

The problems outlined so far apply to the small firm sector in general. However, for companies involved in the commercialisation of innovative new technology, additional considerations are involved. Generally speaking, these companies require larger sums of capital and longer lead times before the investment is recouped than non-technology based companies, and are also perceived as higher risk investments. The success rates for new technology based companies are lower, and mortality rates higher, than for small companies generally. Because of their advanced technology component, evaluating the deals is more costly, as is monitoring the investment. In addition it is often necessary to bring in outside management, marketing and financial advice to supplement the technical expertise of the entrepreneur. These factors exacerbate the general problems already described for small companies seeking equity finance. Compared with the USA, Britain was noticeably worse at supporting such ventures.

Although the Radcliffe Committee's 1961 Report was of the opinion that existing institutions were adequate in supplying the funding requirements of small firms in general, a significant feature of the report was that it identified for the first time the distinctive finance needs of the technically innovative, what might now be called high technology, small company. Radcliffe recognised that the exploitation of technological innovations by small firms was likely to be more risky, more expensive and more difficult to assess than expanding in existing lines of business, making the case for arguing for external funding more difficult:

> 'It is of great importance to our competitive position that we should not lose the fruit of new ideas and inventions to our international competitors, and that

> firms in this country should not be prevented by lack of funds, or by ignorance of the sources of capital open to them, from putting them to use ... It is therefore important that small firms, particularly those engaged in exploiting new technological knowledge, should have access to such capital.' (Radcliffe, 1959:323)

As a result, one of Radcliffe's main recommendations was that a Corporation be established '...to facilitate the commercial exploitation of a technical innovation.' This recommendation led, in 1961, to the establishment of Technical Development Capital (TDC). Initially, TDC had a share capital of £2 million provided by some 40 institutions, but in 1966 its resources were increased by its affiliation to ICFC, one of its original backers. However, by the time of the Wilson Report it was still the case that TDC and the National Research Development Council (NRDC) were the only organisations specifically financing these deals.

The NRDC, set up by the Development of Inventions Act, 1948, was the principal state body in this area. It had first right of refusal to develop any inventions or discoveries resulting from Government-funded research. In addition, its remit was to act as a source of finance for the development and exploitation of inventions and technological innovations when finance was unavailable from other sources. In effect then, the NRDC was a financier of last resort, taking on projects where commercial financiers considered the risks of doing so too great. It did so through joint venture projects with client companies and through the provision of equity and loan finance (Wilson, 1979:64).

TDC's investments had in the main been in one product companies, and at the time of the Wilson report it had only invested £13 million in 150 companies - an average of less than 10 investments a year. This was not due to a shortage of money, but rather, it seemed that TDC was simply not publicised effectively (Wilson, 1979:32).

Although these were the only two bodies specifically responsible for supporting innovative companies, the National Enterprise Board (NEB) was also involved to some extent. Established in 1975 under the Industry Act, it was a publicly funded company designed

primarily to stimulate employment, particularly in areas of high unemployment. Although it was empowered to offer loan capital, its primary form of involvement was through share capital, usually in excess of £100,000 (Wilson, 1979:65).

Also, although not primarily geared to high technology industry, the Scottish and Welsh Development Agencies were both becoming increasingly involved in the support of high technology industry in providing equity and loan facilities for this sector. Similarly, private sector organisations were beginning to show a greater interest in the area. For example, Dimson lists 13 venture and development organisations other than ICFC, TDC and the NRDC as being active in 1977 (Dimson, 1981:135) although how many of these were true venture capitalists is debatable. Wilson noted the lack of interest amongst these providers in start-up capital - for the most part, the private sector companies were effectively development capital companies. Wilson concluded that sources of venture capital were inadequate for what was required, but the situation would only improve as the provision of equity capital for small firms in general improved.

What then was the attitude of these investors to companies and projects? Wilson reports that the NRDC's attitude was to encourage innovators who wished to commercialise their ideas to approach larger companies in the field, whose superior resources in terms of established management, marketing and financial facilities made development of these projects more viable. Although Wilson admitted that this was sometimes appropriate, the Committee also pointed out that the constraints on funds or management time in the large company could put support of these projects in jeopardy (Wilson, 1979:31).

The reason for the NRDC's attitude was that because it was "effectively a lender of last resort", its experience of a high proportion of failures meant that, in choosing investments, they had to obtain high returns on their few successes in order to achieve their statutory obligation to break even. After 30 years, they had achieved only a modest surplus, suggesting that the general view of the NRDC as being:

> "...too expensive, too conservative in their attitude to risk and too large and remote from small investors." (Wilson, 1979:32-33).

was not wholly true. Nevertheless, Wilson believed that had the NRDC taken more risks, they could have shown higher returns. For this reason, Wilson recommended that the NRDC should endeavour to take on more projects, pass on inappropriate projects to other companies, and together with TDC adopt a higher public profile.

In fact, the NRDC and NEB were merged in 1981 to form the British Technology Group. The role of the NEB was progressively down-graded, as it was felt that its functions could be, and were, being carried out more effectively by the private sector. Between 1979 and 1986 the NEB's investment portfolio was reduced from 68 investments valued at £200 million (in 1979) to 3 investments valued at around £5 million. In effect, the BTG has become the NRDC, but without first right of refusal to university and other Government-funded research (Cary, 1987:357). TDC still operates as a branch of 3i, under the name 3i Ventures.

4.7 Influences on the Emergence of the UK Venture Capital Industry in the 1980s.

So far, we have looked at the general position of small firms in the economy, and more specific questions relating to the availability of external funding have been addressed in order to establish the conditions from which which venture capital emerged in the 1980s. Table 4.7 (overleaf) shows just how rapid this expansion has been. A recent Financial Times survey on venture capital in the UK indicates that in 1986, 147 organisations offered venture capital in its various forms (ie including funds for development and expansion finance and management buyouts). Around £1 billion worth of venture funding has been provided. Of these, probably no more than 20 are engaged in 'proactive' venture financing (Financial Times, 1986).

Table 4.7 Venture fund management groups, 1952-1984.

	1952	1972	1975	1979	1984
Clearing bank related	1	4	3	5	13
Institutionally backed	1	9	3	5	27
Independents	-	1	3	6	30
BSS/BES funds	-	-	-	-	30
Corporate/academic/other	-	2	2	3	6
Semi-state bodies	-	-	1	4	10
	2	16	12	23	116

Source: Lorenz, T., 'Venture Capital Today' (Lorenz, 1985:8).

A more extensive survey of the UK venture capital industry, based on published sources of data, is presented in Appendix one.

Whether the venture capital industry is established as a permanent feature of the UK finance scene is difficult to forecast. Certainly the number of players involved and the way in which the industry has become institutionalised - as witnessed by the formation of professional organisations such as the British and the European Venture Capital Associations (the BVCA and EVCA), the founding of trade journals and so forth - would tend to indicate that it is fairly well established. That said, recent experience in the US during the early 1970s shows how vulnerable the sector is to adverse economic conditions, for example changes in tax laws and the availability in capital markets of finance for new issues. Only time will show if the industry is sufficiently robust to withstand unfavourable conditions such as these.

More importantly, we should ask why the industry has developed at this time. The need for this form of financing was, after all, long standing as both the Bolton and Wilson reports show. In other words, it would seem that venture capital has not appeared primarily to meet the financing needs of small firms - which would seem to be its main purpose. That it is a fairly recent phenomenon indicates that conditions were not previously conducive to its establishment, and begs the question what has happened to alter this state of affairs?

This shift in emphasis to the funding of small, particularly innovative, firms is often ascribed to the markedly worsening

economic environment of the 1970s. The impacts of this are clearly visible in the radical rationalisation and restructuring of the traditional manufacturing base and consequent massive increases in unemployment. This has brought about three main problems which are often held to account for the rapid rise of venture capital (Lorenz, 1985):

(i) the need to ameliorate the effects of unemployment;
(ii) the requirement of funding institutions to seek alternative investment opportunities into which their funds can be channelled;
(iii) the recognition of the need to update the industrial base with new innovative industries.

Ostensibly these problems can be met by a strong small firm sector, which accounts for the development of a generally supportive environment for new firm creation. That said, none of these factors has any real direct influence on the emergence of venture capital.

Any further discussion depends on how venture capital is defined. If we accept that 'true' venture capital investment is geared towards the needs of new companies in high technology activities, then the argument that venture capital has emerged as some sort of private sector initiative to deal with unemployment cannot be justified. Almost by definition, high technology companies are not employment intensive: their potential for job creation is no better than for manufacturing firms in general. In addition, the rates of formation of high technology firms are too low to make any significant impact on levels of unemployment (Curran,1986:35).

It can be argued, however, that this definition of venture capital is too restrictive. For example, a substantial proportion of businesses backed by venture capital are projects seeking to exploit market opportunities over a wide area, such as consumer goods, and in the service sector (Shilson, 1984), the development of which has been encouraged in order to create new jobs in areas of high unemployment. Nevertheless, the role venture capital plays here, relative to other Government and institutional measures, is a peripheral one.

Similarly, the argument that venture capital is a response to the need of institutions to find alternative outlets for investment can largely be discounted as a major factor in the development of the industry. For example, relaxation of oversea's investment legislation has seen a massive outpouring of funds into investments in other countries - in 1985, £22 billion was invested abroad, the eighth successive annual rise - suggesting that alternative investment opportunities exist in any case for the financial institutions. Furthermore, the amount of money committed to venture capital is, by comparison with that invested in other areas, extremely modest. Again in 1985, total fixed investment within the UK was an estimated £65 billion (Huhne, 1986). At best, we can say that venture capital provides a relatively minor additional outlet for institutional funds, which is different in kind from suggesting that the institutions were in any way actively instrumental in the development of the industry.

Finally, there is the argument that the need to update industry and support innovative small companies has somehow pulled funds into venture capital. There is perhaps more merit here than in the preceding arguments - if we can accept the premise that venture capital deals primarily with innovative enterprises. But to argue that the need to innovate and create new industries caused an influx of risk capital into venture institutions would seem to imply a radical change in the behaviour of a highly conservative financial establishment. This discussion has stressed at several points that the need to update industry has existed since the Second World War and, as we have seen, the financial institutions have long been criticised for their contributory role in this respect to Britain's decline. Again, to argue that the need to innovate played any direct role in the establishment of venture capital would appear erroneous.

In summary, the three main problems caused by the recessionary environment of the 1970s have little more than peripheral importance when examining the reasons for the emergence of the venture capital industry in Britain. Therefore, it is necessary to look elsewhere for explanations.

4.7.1 The American example and its influence on Britain.

In doing so, it is appropriate to look in the first instance to the United States where the venture capital industry has been active since shortly after the Second World War. Initially the province of a few wealthy individuals, its origins were in Roosevelt's 'New Deal' of the early 1930s. These early venture capitalists saw the need to provide small companies with long term finance and equity capital, but it was not until the passing of the Small Business Investment Act in 1958 that the industry was put of a more formal basis. Important in this respect was the formation of small-business investment companies (SBICs) under the 1958 Act.

There are now basically four sources of venture capital in the US. First, there are the SBICs, of which around 360 exist. Second, around 100 venture capital offshoots of large companies and banks have been established. In addition, some 130 private venture capital firms have been formed. Fourth, private citizens are still active as investors in their own right. Hoffman (1972) identified 138 individuals as providers of venture capital in the cities of Austin and Waco in his study of regional economic development in Texas. Together with academia, industry and government, venture capitalists have formed an innovation network over the last 30 years, one which has been crucial to the application of investment capital through the informal contacts it provides (Bullock, 1983). However, the American experience has shown just how sensitive venture capital investment is to legislation, particularly tax legislation, and the general economic environment. In 1975, following increases in company taxation and in the aftermath of the oil crisis of 1973/4, venture capital investment reached its low point with only $25 million being invested. In contrast, by 1984 some $6 billion had been committed (Financial Times, 1984). Also, as Chapter three has shown, venture capital is highly susceptible to 'follow-my-leader' investment trends.

The existence of America's well developed venture capital industry and its more deeply entrenched tradition for the support of entrepreneurial activity was a major influence on the thinking of the newly elected Conservative administration in 1979. It would,

however, be simplistic to see Britain's interest in venture capital financing as a straightforward attempt to copy the US example. For instance, there is no equivalent here of either the Small Business Administration or the Small Business Investment Companies. The idea of creating such a body has been disregarded as inappropriate to the UK situation. What the US case has demonstrated is the viability of a high technology development strategy based on small firms, as witnessed by the proliferation of small firm activity in engineering, semi-conductors and biotechnology, and the quite spectacular success of some of these companies.

The US venture capital industry had a much more direct influence in bringing 'true' proactive venture capitalism to Britain in two ways. First, there was the establishment of offshoots of US venture funds in the UK in the late 1970s. These companies, including Advent, Alan Patricof Associates, Thompson Clive and Venture Founders, were highly proactive in their relationship with portfolio companies and quite unlike any previous type of venture capital institution in the UK. To what extent they operated as role models for subsequent venture capital outfits is difficult to assess, but they did demonstrate that highly proactive-style US venture management could work in Britain.

Second, the US industry served as a training ground for a significant proportion of senior management in the present UK venture capital industry and the influence of this is disproportionate to the numbers involved. In other words, when the environment for venture capital came about an embryonic management structure already existed, the evangelical zeal of which should not be underestimated. It should also be mentioned that the ICFC has also played a major role in this respect, with some 10% of managers employed in venture capital in Britain have been previously employed by ICFC (Clark, 1987:74).

But the two most important factors contributing to the establishment of venture capitalism in Britain were the creation of a second, lower, tier of entry to the Stock Market, the Unlisted Securities Market (USM), and the policy of the Conservative administration from 1979 onwards which has been

geared towards the creation of an entrepreneurial environment. The most important aspect of this policy as it concerns venture capital have been reforms made in company and individual taxation.

4.7.2 The creation of new markets for equities.

As was noted earlier in section 4.5.2, one of the major impediments to investment in unquoted securities was the lack of a ready market on which they could be traded. Two facilities did exist - an over-the-counter (OTC) market operated by MJH Nightingale, and rule 163(2) of the Stock Exchange which allowed occasional dealing on a relatively ad hoc basis in unlisted securities. However, these were not especially popular. The OTC market dealt with relatively few companies - only 14 of an estimated 800 eligible companies at the time of the Wilson Small Firms report, whilst rule 163(2) had the disadvantage of pricing shares at up to a 50% discount compared with equivalent listed companies (Wilson, 1979:14-15).

The inadequacies of these arrangements meant that the most effective way of realising an equity investment was through sale of the investee company to another business, and indeed most exits are still achieved in this way. In view of this, the Wilson committee (1980) highlighted the need for a mechanism whereby a young company could gain a Stock Market listing.

The formation of the USM, in response to the demand noted by Wilson, offers holders of small firm equities a mechanism to realise their investments. It also provides the companies concerned with a market in which to raise external equity funding for development. The USM gives companies access to capital markets with less rigorous entry criteria than those required for a full stock market listing, as is shown in table 4.8 overleaf. Formed in 1980, it has developed from rule 163(2) (which was itself consolidated into rule 535(2) of the Companies Act, 1984) and is designed to be both a transitional staging post for companies en route to a full listing, as well as being an entity in itself. With 373 companies at the beginning of 1987, and capitalised at almost £5 billion, the USM had established itself in both roles (Rawsthorn, 1987). After 5 years of operation some 10% of USM

companies had graduated to a full Stock Market placing (Lorenz, 1985:110-111). It is also possible for companies with full listings to transfer down to the USM.

Table 4.8 Stock Market and Unlisted Securities Market listing requirements: a selective comparison.

Entry to market	Full listing	USM
Minimum percentage of equity to be held other than by vending shareholders.	25%	10%
Minimum size (market capitalisation)	£500,000	No lower limit
Company status	PLC	PLC
Trading record	5 years	3 years

Source: Derived from Cucksey, J. and Medland, P., 'The Unlisted Securities Market: A Review', (Cucksey and Medland, 1984), p.7.

In January 1987, the Third Market was established to cater for companies either too small of too speculative for a USM listing. In contrast to both the main stock market and the USM, the only entry requirements for the Third Market are that the company has traded for one year and that member firms of the Stock Exchange who sponsor companies coming to the market should be satisfied they are suitable for membership. 'Green field' ventures are also allowed, providing they have a well thought-out business plan. (Batchelor, 1987).

The existence of both the USM and the Third Market means that investors have been able to take a more favourable view of investing in equities, as a mechanism for realising their investment now exists.

4.7.3 Taxation and the Business Start-up and Business Expansion Schemes.

We turn now to the effects of government policy and the role played by the Conservative administration in encouraging small business. Section 4.3 outlined the historical background to this,

and recent legislative changes can be seen as a continuation of a process initiated by Bolton. But most of the direct actions of government aimed at producing an 'enterprise culture' - some 100 or so legislative measures including regional aid programmes, enterprise allowance schemes and so forth - have little if any impact on the type of business venture capital caters for. The most important legislation in this respect concerns taxation.

Since the Second World War the burden of taxation had increased considerably in the UK, as it had done in other developed countries, and many saw this as one of the reasons for the overall decline of the small firm sector:

> '...in the mind of the average small businessman and to a large extent in those of his professional advisers also, high taxation ranks as the most important single factor in the inhibition of enterprise and the decline of the small firm sector.' (Bolton, 1971:193).

However, it was beyond the remit of the Committee to recommend changes in the overall tax structure - rather, it looked for examples of discrimination against the small firm sector within the existing tax system, in order to recommend tax changes as appropriate.

The Committee concluded that in certain instances high levels of taxation did inhibit enterprise, tilting the risk - reward equation of setting up a new business away from reward, although they also concluded that there were still substantial rewards to be made from establishing a successful business. For established firms, it appeared that high tax levels did seriously inhibit expansion. What compounded the tax problems were the high levels of inflation experienced in the post war period, then standing at 10% (Bolton, 1971:197).

This combination, of high taxation of profits and high inflation rates, meant that raising finance for expansion through retained profits had become more difficult. As a result, businesses were finding it necessary to seek external funding - something they were often unwilling to do in any case, and frequently unable to do in practice.

Overall, the Bolton Committee found there was no case to be made for the preferential tax treatment of small firms, believing that stimulation for the sector would come from reductions in personal taxation of incomes and estates, which would benefit all sectors of society (Bolton, 1971:200). This view was supported in evidence to the Wilson Committee in 1979 by the NRDC who stated:

> '...any lack of encouragement for innovative firms in the UK is more a criticism of the taxation system than the arrangements for direct financial support from the public sector.' (Wilson, 1979:26)

One of the first acts of the incoming Conservative administration of 1979 was to reduce top rates of tax to 60%. Evidence that this, and subsequent, reductions in personal taxation have in any sense led directly to a rise in entrepreneurial activity, or to what degree lower personal taxes are a contributory factor in this, is difficult to quantify. It may be true that it has assisted in increasing, perhaps considerably, the incentives to start up businesses. However, there are other reasons which may account for the emergence of the small business culture and the scientific entrepreneur in Britain.

It could be argued that of equal, if not more, importance has been the opportunities offered by the emergence of new 'high tech' industries (such as electronics and biotechnology) which small firms can play a major role in developing. Here, the example offered by the American experience - of Silicon Valley - may have played a key role. In addition, adverse economic conditions have led people to consider self employment as an alternative to traditional career paths, frequently out of necessity.

Therefore, a number of factors have contributed to the emergence of the high technology entrepreneur over the last 10 years. In itself, this has marked an important change in the philosophy of academic and corporate scientists, technologists and managers towards the commercialisation of research. However, this can probably be more properly described as an abstract 'identification of opportunities' in which reduction of personal levels of taxation plays no more than a participatory role.

A direct role played by Government in encouraging private investment in industry through tax concessions was the Business Start-up Scheme (BSS), established under the 1981 Finance Act. The failure of this scheme to attract the levels of investment the Government had hoped for - in the two years of its existence, it only managed to raise around £13 million - led to the more liberal Business Expansion Scheme (BES) being established in 1983.

> 'The biggest single impetus to venture capital in Britain in the last couple of years has, arguably, been the BES ... which offers investors special tax incentives to invest in unquoted trading companies' (Financial Times, 1986:I).

Under the BES, individual investors who supply capital for small firms either directly of through specially created BES funds, can deduct the sums invested from their taxable income. The aim was to give high earners a strong incentive to invest in unquoted companies. The regulations of the BES scheme have been modified in successive budgets; in 1986 investors could claim tax relief on investments up to £40,000 in unquoted companies. So, for example, investor's paying the then top tax rate of 60% and investing £10,000 in a qualifying company actually paid a net £4,000. The qualification is that the investment must be held for a minimum of 5 years.

The scheme has not been without its problems. The liberalisation of investment guidelines represented by the BES - funds could now be used for the expansion of existing businesses as well as the creation of new ones - raised £105 million in 1983/84 alone. But loopholes in the legislation governing BES investment meant that, given the desire of individuals for capital maintenance, a large proportion of the funds raised were going into existing companies to finance expansion and private investments in projects such as farming, property development, racehorse breeding and the like. The investment opportunities the BES was originally intended for, namely those situations which where regarded as too high risk for conventionally based investment, were less well catered for. Nevertheless, there were 29 BES fund management organisations in existence in 1983 (managing over 60 BES funds which represented some £200 million of private investment) representing by far the

largest source of non-institutional investment in venture and development capital (Stoy Hayward, 1986). Of this, only a small proportion of funds were placed in 'sunrise' industries, with most (45%) going to projects involving consumer-related and industrial products (Curran, 1986). Table 4.9 below provides a summary of BES investment to April 1986.

Table 4.9 Business expansion scheme investment statistics.

	Year to 31st March:				
	1982	1983	1984(a)	1985	1986
A Funds					
Number of funds	5	7	27	41	34
Number of investees	18	71	205	220	182
Capital:					
raised (£m)	10	5	45	47	37
invested (£m)	2	11	42	50	37
B Direct					
Number of investees			24	70	102
Capital invested (£m)	Very little activity		30	80	110
C Total investment	2+	12	72	130	140(?)

(a) Business Expansion Scheme replaces Business Start-Up Scheme.

Source: Cary, L., 'The Venture Capital Report Guide to Venture Capital in the UK', (Cary, 1987), table A, p.221.

In summary, the establishment of the BES and the formation of the USM, both of which may be considered to be public policy initiatives linked to the recent increased emphasis on the small firm, have had a catalytic effect in mobilising private sector venture capital, both individual and institutional, in Britain (Rothwell, 1985).

4.8 Summary.

This Chapter has described some of the key factors which have accounted for the decline of the small business sector in Britain

in the post war years. It was shown that, until the late 1970s, the small firm sector in the UK contributed less in relative terms to the economy than was the case in any of the UK's major competitors. The main reasons for this were identified as being the overall poor performance of the UK's economy, industrial concentration, and the growth of the financial institutions. Because the concentration of industrial investment in the financial institutions worked against the interests of small firms, particular emphasis was placed on the availability of long term equity finance as perhaps the most important reason for the small firm sector's poor performance.

The recognition of the special financing needs of technologically-orientated small firms can be traced to the 1959 Radcliffe report. Despite some initiatives designed to make funding available for these firms, it was only with the advent of the venture capital industry in the late 1970s that finance finally became available on an adequate scale.

Therefore, the development of venture capital in Britain in the 1980s can be seen to signify both a marked reversal in general attitudes to the role small firms play in the economy and more specific changes in the investment philosophies of financial institutions. This discussion has shown that influences on the emergence of venture capital were:

(i) the example provided by the establishment of US venture capital offshoots in the late 1970s which showed the viability of financing high risk start-ups in the UK;
(ii) the formation of the Unlisted Securities Market in 1980;
(iii) the establishment of the Business Start-up and Business Expansion Schemes in 1981 and 1983 respectively.

Of these, the formation of the USM was probably the most important single factor. In providing a market for small firm equities, it made possible the realisation of investments in small firms and, in doing so, made investment in such firms attractive to both institutional and private investors.

In summary, these findings throw doubt on the notion that venture capital emerged in response to the demand for finance for small firms. Rather, the industry can be shown to have developed as a result of institutional changes which made investment realisation easier.

Nevertheless, venture capital has come to be seen as one of the cornerstones of the re-industrialisation of Britain, through its role in financing new companies in strategic industries such as those based on biotechnology. In the next Chapter, a literature review of the way in which venture capitalists identify, evaluate and invest in new firms is presented.

CHAPTER FIVE

VENTURE CAPITALIST PROJECT ASSESSMENT AND EVALUATION PROCEDURES

5.1 Introduction.

This Chapter contains a review of the literature describing the venture capital investment process. The point of focus for the discussion is to find the framework within which investment decisions are made, and the nature of the investment decision. First, however, the relationship of venture capital investment appraisal to the appraisal of other investment opportunities will be presented.

5.2 Analysing Investment Opportunities.

An extensive body of literature exists describing techniques of investment appraisal (concentrating solely on the financial implications of investment decisions: for example, Davis and Pointon, 1984; Jones, 1985) and research and development project assessment and evaluation (where other aspects of the project, such as technical and marketing features, are taken into consideration in formulating the investment decision: see Freeman 1982; Twiss, 1986). However, the objective of this Chapter is not to describe how these techniques are adapted to serve the needs of venture capital investment decision making. Rather, the aim here is to find how venture capitalists manage to identify suitable investment candidates where a considerably larger degree of uncertainty exists on the outcome of a decision to invest.

Any technique of investment appraisal contains an element of uncertainty. The point of the appraisal process is to convert this unmeasurable uncertainty into measurable risk. Even so, the degree of accuracy of, for example, a discounted cash flow forecast is dependent on the reliability of the information used in constructing the forecast. Techniques such as sensitivity analysis can indicate a range of possible outcomes arising from a particular course of action. The institutional investor further

seeks to minimise risk through, for example, holding a diversified portfolio of investments. Nevertheless:

> '... the decision to invest is essentially a matter for the exercise of managerial skill and expertise. This exercise may be aided by certain calculations, which of necessity will only be as good as the forecasts on which they are based.' (Jones, 1985:282)

Indeed, the extent to which formal academic techniques are used in the appraisal of investment opportunities in real life cases is limited. This is in part because of lack of understanding of the procedures (Hodder and Riggs, 1985). It is also because of the subjectivity of project evaluation. The uncertainty and risks associated with investment analysis are considered further in Freeman (1982) and Twiss (1986).

5.3 The Objective of Venture Capital Investment.

The aim of venture capitalist investment is to gain equity stakes in small, fast growing companies and realise this investment through disposal of their equity stake at some future date. In identifying suitable investment candidates, the venture capitalist faces a number of unique problems, which can most readily be understood in terms of the characteristics of the investee companies themselves. These characteristics can be briefly summarised as companies:

(i) having a short, if any, performance history;
(ii) typically being relatively small scale operations;
(iii) having relatively weak access to supply and distribution networks;
(iv) often having an innovative component, the technical and/or commercial future of which is uncertain (Tyebjee and Bruno, 1984a:15).

Whilst techniques of both investment appraisal and project evaluation are applicable to the venture capitalist's assessment of investment opportunities, it can be seen that these characteristics increase considerably the degree of uncertainty in the evaluation process. On the one hand, financial institutions

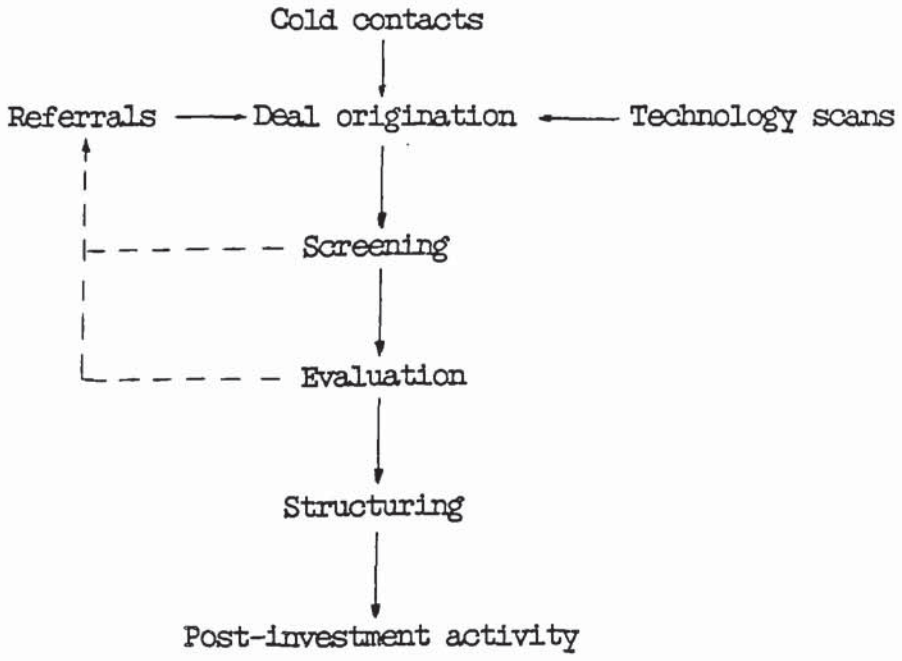
wishing to invest in quoted securities have some track record of company success on which to judge the performance of the investee company, both historically and against that of rival companies operating in the same industrial sector. On the other hand, the R&D manager assesses projects in the context of the firm's overall strategic goals. The venture capitalist has to arrive at analogous decisions, often without a track record of company success, in the absence of competitor firms (or in the presence of larger, established potential competitor firms) against which product acceptance can be gauged, and with an outsider's view of the strategic significance (if any) of the technology involved. Finally, the investees have the usual problems of survival and growth associated with small firms, described in the previous Chapter.

The evaluation process is a rigorous one, filtering out the vast majority of proposals seeking finance. Evidence from a number of studies (Wells, 1974; Poindexter, 1976; Charles River Associates, 1976) indicate that only around 1% of entrepreneurs seeking venture financing are successful. The procedure these proposals must go through will now be described.

5.4 The Nature of the Venture Capital Project Assessment and Evaluation Procedure.

Tyebjee and Bruno (1984a, 1984b and 1984c) describe a five-stage decision process model (see figure 5.1 overleaf) by which venture capitalists assess any particular investment candidate. This present discussion focusses on the deal screening and evaluation stages, although it is also necessary to consider the deal origination stage.

Figure 5.1 Decision process in formulating the investment decision.



Source: Tyebjee, T.T. and Bruno, A.V. 'Venture Capitalist Investment Activity', (Tyebjee and Bruno, 1984c), p.1053.

5.5 Deal Origination.

Venture capitalists become aware of investment opportunities in several ways. Table 5.1 below summarises the findings of two US studies which included investigations into deal origination.

Table 5.1 Sources of business proposals.

Source of proposal	Study A % of deals	Study B % of deals
Unsolicited cold calls	35.8	30.6
Finders, brokers	10.9	30.6
Other venture capital companies	17.1	10.4
Banks, investment brokers, portfolio companies	21.3	1.4
Accountants	2.2	0.7
Contacts of partners	N/A	23.6
Other	12.7	2.8
	100.0	100.1

Sources: Study A = Diebold Group Inc., 1974.
Study B = Wells, 1974.

5.5.1 The source of proposals.

Table 5.1 indicates that around one third of all contacts are made directly by potential investees either informally via the telephone or more formally by sending the venture capitalist a business proposal. The majority of the remainder reach the venture capitalist through intermediaries, such as accountants or stockbrokers, or through a network of contacts, including other venture capitalists, affiliated organisations and informal personal contacts.

5.5.2 Syndication.

Proposals often become known when an investor seeks to syndicate a deal. Syndication is a funding strategy where two or more funds invest in the same business proposal. Syndication is sought mainly because of funding constraints on individual venture capital funds. Few companies are prepared, or able, to invest more than £1 million in any single investment opportunity. Therefore, syndication allows attractive higher priced deals to be financed. Syndication may also be sought for two additional, related reasons. First, it allows venture capitalists to mitigate the risk of any one investment, by sharing this risk with a co-investor. Second, syndication is a relatively simple mechanism for portfolio diversification, particularly where the investment is made as a co-investor rather than as syndicate leader, as the syndicate leader will be the most active in handling the day-to-day running of the investment.

5.5.3 Active searches for investments.

A third mechanism of deal origination - the active search for investment opportunities - is little used in the UK. A few US venture capitalists do actively pursue potential opportunities through technology scans, attendance at trade fairs, conferences and so forth (Wells, 1974).

5.5.4 Effect of source of proposal.

The source of a proposal does have important consequences on its subsequent evaluation. Where intermediaries are involved, certain organisations, for example other venture capital companies or investment brokers, operate essentially as deal screeners, referring only those proposals known to be of interest to a particular venture capitalist. Inevitably, if a proposal is referred from a reliable source, it is treated more favourably.

5.6 Deal Screening.

Venture capitalists receive far more proposals than they can possibly invest in, both because of limits on the amount of finance any single investment institution has available and, similarly, because of limited manpower resources. Deal screening reduces the total number of proposals received to a more manageable number of potential investment candidates on which more detailed evaluations can be undertaken.

Deal screening criteria reflect a venture capital fund's structure and specialisms. Lorenz (1985) describes the principal criteria employed as;

(i) the state of development of the investee company (ie. whether the proposal is for a start up company or one which has some track record),
(ii) the fund's investment size range (the minimum and maximum amounts of finance available for any one deal, and whether the fund will syndicate),
(iii) the fund's technological and/or market sector focus, and
(iv) the geographic location of the venture.

Screening criteria will also include the preferred time scale to investment realisation and preferred financing instruments, reflecting the degree of emphasis placed on investment income versus capital growth.

Wells offers a complementary perspective on the deal screening process in presenting a generalised model which contains both

venture capital firm general and firm specific criteria. The following four criteria were found to be common for Well's seven participating venture capitalists:

1) Is the entrepreneurs background appropriate for this venture?
2) Is the business plan sufficiently well advanced?
3) Is the business proprietary?
4) Is the investor group satisfactory?

In contrast, the following five factors were applied differently between the participants:

5) Is the size of the investment satisfactory?
6) Is the line of business satisfactory?
7) Is the stage of development satisfactory?
8) Does the venture have adequate potential size?
9) Is a written proposal required? (Wells, 1974:187)

One interpretation of Wells' findings is that the former group of factors were seen to represent a set of fundamental characteristics necessary for the success of any business, whilst the latter reflects the individual venture firm's deal screening criteria, as outlined by Lorenz above.

5.6.1 Stage of development of investee company.

Involvement in financing early stage companies is inherently more risky than investment in later stage projects. For this reason the venture capitalist will seek a higher reward to compensate for the additional risk involved. It is on this type of investment that the reputation of venture capital rests. The ideal of the early stage investor is to provide seedcorn or start-up finance for companies which will go on to develop into major corporations in their industry sector.

Venture capitalists with a lower risk profile will tend to look more to later stage financings, such as companies seeking development or expansion finance, or those seeking finance for management buy-outs (MBOs). Here, the risk is lower because there is some track record of achievement which can be measured. The

risk of failure for such later stage investments is reduced compared to early stage financings. However, the rewards from such investments are similarly lower since, in percentage terms, the amount of growth of such companies (given they are already established) will usually not be as spectacular as for a successful start-up firm. In addition, the amount of finance required to gain an equity stake in such investments will be proportionately higher.

Table 5.2 below shows the investment preferences of 96 UK venture capital firms. Note that most are involved in more than one type of financing; there are relatively few who specialise solely in, for example, start-up or MBO financings. Similarly, the take-up rates for higher risk (early stage) financings is generally lower for a generalist fund and may only indicate that such financings are considered but only rarely undertaken.

Table 5.2 Stage of financing undertaken.

Type of financing	Number of firms considering investment
Research and development	29
Start-up/early stage	79
Expansion/development	92
Management buy-out	78
Secondary share purchase	44
Rescue/turn-around	35
Other	7

Source: Derived from Venture Economics 'Guide to European Venture Capital Sources 1985' (Pratt and Lloyd, 1985).

To summarise, the stage of financing undertaken reflects the venture capitalist's risk profile: the earlier the stage, the higher the risk; the later the stage, the more likely it is that the risk elements of the investment can be quantified and the subjective components of the evaluation minimized.

5.6.2 Investment size range.

The minimum and maximum amounts of finance considered for any one investment is, to a large extent, determined by the stage of finance undertaken. As was stated above (section 5.6.1) the price in absolute financial terms for entering later stage, less risky projects is higher than that for entering early stage projects. Therefore, low minimum funding levels can reflect an investor's interest in early stage financings.

5.6.2.1 Minimum funding levels.

Two other factors need to be taken into account in considering minimum funding levels. First, because of cost of scale effects, it is relatively more expensive to evaluate lower priced deals: it costs roughly the same in both time and money to investigate a deal where £100,000 is sought as it does for a £500,000 deal. Second, the degree of involvement required for a portfolio company, in terms of time spent in post-investment activities, is again essentially the same irrespective of the amount of finance involved. Thus venture capitalists cannot afford to spread their portfolio over a large number of small investments and tend to look to a smaller number of higher priced deals instead (Tyebjee and Bruno, 1984c). For UK venture capitalists as a whole there has been a tendency to look for higher priced deals, a trend reflected in the increase in minimum funding levels considered in three successive Financial Times guides to venture capital sources (Financial Times, 1984; 1985; 1986 - see also Appendix 3). As a result it is not unusual for entrepreneurs seeking relatively small amounts of equity funding to experience considerable difficulties in raising this type of finance, other than from specialist seedcorn companies which are often public-sector owned (for example the Scottish and Welsh Development Agencies). To this extent, it would appear that the funding gap first identified by the MacMillan Committee in 1931 (see section 5 of Chapter four) still exists to some degree.

What problems this gap poses for high technology companies is difficult to assess. Whilst there does appear to be a shortage of funding between about £30,000 and £100,000, most high technology

companies require funding substantially in excess of this level, reflecting their higher start-up costs. (Table 6.1 in Chapter six provides details of UK venture capital investment in biotechnology companies, showing that nearly all such investments have been in excess of £100,000). It is likely, therefore, that minimum funding levels exert more constraints on small company formation and development in non-high technology areas. Experience from the US venture capital industry indicates this may be a problem for the 'low-tech' firm, since less than one third of venture capital funds are involved in financing new businesses, nearly all are involved in funding low- to medium-technology firms and few are exclusively high-technology orientated. In the UK, less than one in ten venture capitalists can be considered to be exclusively high-technology investors (Lorenz, 1985).

5.6.2.2 Maximum funding levels.

The maximum funding levels depend on the capitalisation of the venture capitalists portfolio and the desire to maintain a diversified portfolio. However, constraints at these upper limits can be circumvented by syndicating deals, as described in section 5.5.2. This flexibility at the upper end of funding levels is reflected in the extent of syndication. Brophy (1981) estimates that about 80% of venture capital deals struck in the US in 1980 involved more than one fund, with a third involving five or more companies. Similarly, Tyebjee and Bruno (1984a) found that of 90 investments, 56% involved the participation of more than one venture capitalist.

5.6.3 Technological and/or market sector focus.

Very few funds - Biotechnology Investments Ltd. is one - limit themselves to one specific technological area. However, these industry sector-specific funds are investing in more than just a company; they are investing in the future prospects of a particular technology (or group of related technologies) and its (or their) associated market.

For more proactive funds, there tends to be some degree of technical specialisation. This reflects in part the individual

venture capitalist's interests, and in part the limited extent to which a team with a 'hands on' approach to managing their investments can have technological empathy with their investees.

In contrast, reactive funds tend to be more general in the types of industries they invest in. They also tend to rely more on outside sources of technological expertise in their evaluations.

5.6.4 Geographic location of the venture.

This criteria reflects, in part, the degree of hands-on, post-investment involvement required by the venture capitalist. In order to save costs it is preferable to have investee companies within relatively easy access. Likewise, entrepreneurs seeking funds are more likely to approach local sources of finance before searching further afield. Table 5.3 shows the geographical preferences expressed by 96 UK venture capital funds.

Table 5.3 Geographical preferences of UK venture capital funds.

Geographical area*	Number of companies
1. National (UK):	
All regions	75
Regional funds	18
UK specific funds	47
2. Europe	42
3. USA	38
4. Far East	12
5. Other	10
6. No preference expressed	2

*It should be noted that investment overseas may be through direct participation by the venture capitalist, through investment via affiliated funds which are able to exert local control over the investee, through syndication with foreign venture capital firms, indirectly through a passive equity stake in a foreign-owned venture capital investor, or through a combination of two or more of these mechanisms.

Source: Derived from Venture Economics 'Guide to European Venture Capital Sources 1985' (Pratt and Lloyd, 1985).

5.6.5 Initial meeting with entrepreneurs.

Even if a proposal meets the venture capital firm's deal screening criteria, an initial meeting with the management team of the venture is crucial in deciding whether to proceed with a more detailed evaluation of the business opportunity. This meeting may also persuade a venture capitalist that a proposal which appears to be of only marginal interest on paper is in fact worthy of further investigation. For this reason, the first meeting with the entrepreneurs may be considered to be the final stage of the screening process, as well as the first stage of the evaluation procedure.

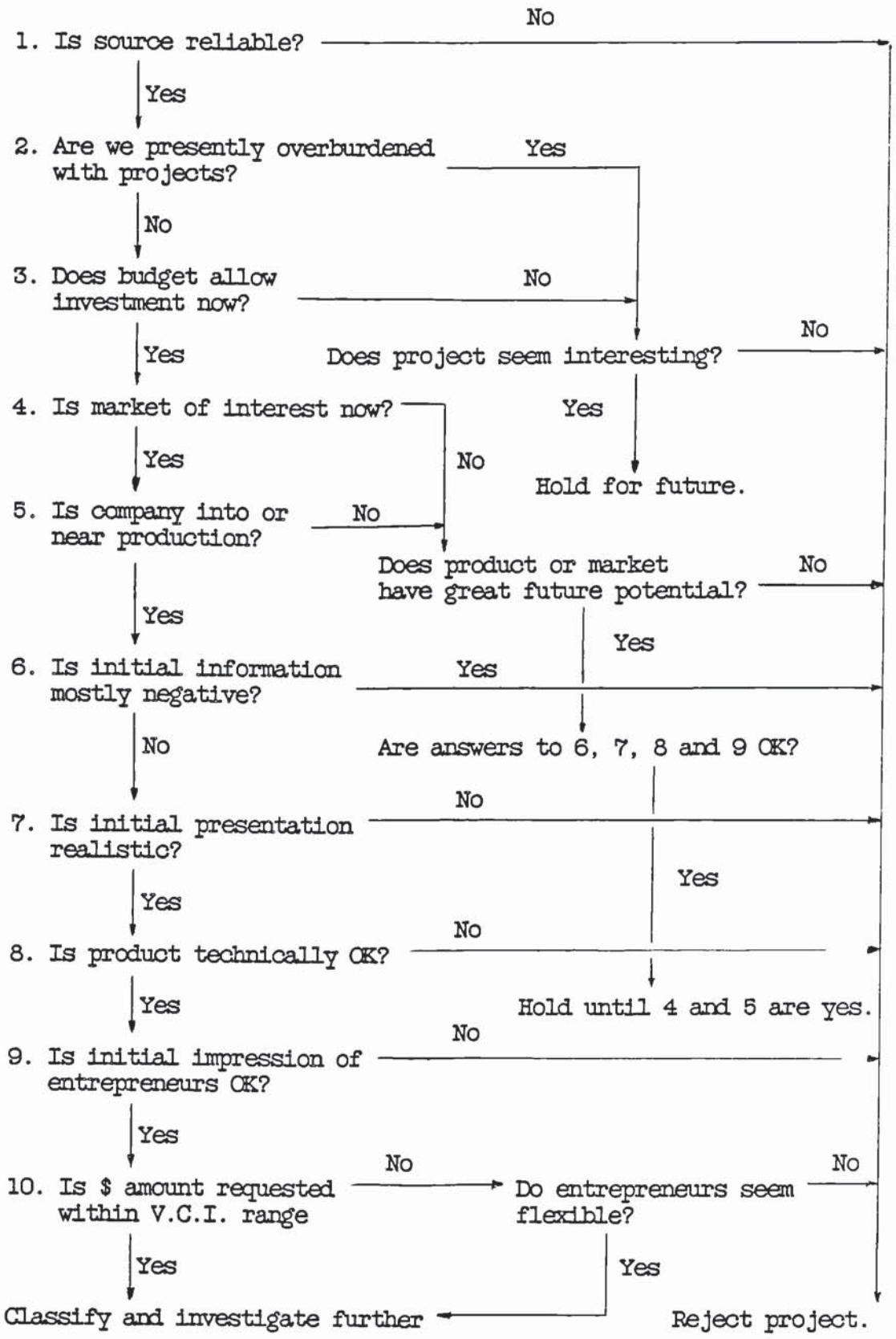
Figure 5.2 on the next page presents a representation of the deal screening process of a US venture capital firm. Although the procedures outlined are specific to this firm, the model provides a useful overview of the kind of procedures proposals must negotiate in order to obtain funding.

5.7 The Evaluation Procedure.

Assuming a proposal meets a venture capitalist's deal screening criteria, it will now be subjected to an evaluation in which the components of the business proposition will be examined in considerable detail. This is somewhat simpler for a later stage investment than for a start-up. In the case of the former, there will be some track record of historical performance on which the venture capitalist can base their judgement of the soundness of the proposition. For early stage investments, usually the only resource which can be measured on an historical basis is management potential.

So, particularly for early stage propositions, how is the investment decision reached? Why do some venture capitalists decide to invest in a proposition whilst others turn down the same opportunity? Most literature on the subject tends to concentrate on factors looked at in the business plan - the elements which form the basis on which the investment decision is reached. To date, however, it has proved impossible to state why a particular decision is reached on a predictive basis, as the decision process

Figure 5.2 A model of a venture firm's deal screening process.



Source: Briskman, E.F., "Venture Capital: The Decision to Finance Technically-Based Enterprises" (Briskman, 1966)

has been found to be too subjective to be amenable to quantitative analysis.

Table 5.4 (overleaf) summarises the findings of three studies which have sought to identify the key characteristics of the investment process. In all three cases, pre-eminent amongst all other characteristics is the quality of the management team involved in the venture. It should be noted that the three studies cited are not strictly comparable: Wells (1974) looked at venture evaluation from a management perspective and Poindexter (1976) from a finance perspective. The Tyebjee and Bruno study (1984a), noting these biases, used an open ended questionnaire methodology as:

> '... open ended interview techniques should enlist the kinds of criteria which are operative, free from the biases introduced by the a priori specification of criteria based upon the researcher's predispositions (Tyebjee and Bruno, 1984a:20).

Nevertheless, it is of interest to note how these findings correspond with those of Johnson, displayed in table 5.5 (below), which describe why businesses failed to obtain funding.

Table 5.5 Major determinants of funding rejection.

Category	Most frequent reasons	Less frequent reasons
Management	39%	23%
Finance	32%	32%
Marketing	3%	13%
Policy*	15%	22%
Business plan	11%	10%
Sample size	144	357

*As described by Johnson, these are deal screening criteria.

Source: derived from Johnson, J.M., 'Determinants of Unsuccessful Risk Capital Funding by Small Business' (Johnson, 1979).

It is apparent from these studies that the management team are seen as the key to business success and, in most instances, the

Table 5.4 Venture evaluation criteria.

(1) Sample: 7 venture capital firms

	Factor	Average weight
1	Management commitment	10.0
2	Product	8.8
3	Market	8.3
4	Marketing skill	8.2
5	Engineering skill	7.4
6	Marketing plan	7.2
7	Financial skill	6.4
8	Manufacturing skill	6.2
9	References	5.9
10	Other participants in deal	5.0
11	Industry/technology	4.2
12	Cash-out method	2.3

(2) Sample: 97 venture capital firms

	Investment criteria by rank order of importance
1	Quality of management
2	Expected rate of return
3	Expected risk
4	Percentage equity share of venture
5	Management stake in firm
6	Financial provisions for investor rights
7	Venture development stage
8	Restrictive covenants
9	Interest or dividend rate
10	Present capitalisation
11	Investor control
12	Tax shelter considerations

(3) Sample: 46 venture capital firms

	Factor	% of respondents mentioning
1	Management skills and history	89
2	Market size/growth	50
3	Rate of return	46
4	Market niche/ position	20
5	Financial history	11
6	Venture location	11
7	Growth potential	11
8	Barriers to entry	11
9	Size of investment	9
10	Market/industry expertise	7
11	Venture stage	4
12	Stake of entrepreneur	4

Sources: (1) = Wells, 1974
(2) = Poindexter, 1976
(3) = Tyebjee and Bruno, 1984

primary determinant of the investment decision. That said, a few highly pro-active funds in the UK - Venture Founders and MTI are two examples - will occasionally construct a company, including the management team, around a particularly promising technological innovation.

5.7.1 Understanding the evaluation decision.

The studies described below have attempted, using a number of different approaches, to understanding the characteristics of the venture capitalist investment decision.

Hoban (1976) attempted to formulate a set of predictive variables for selecting successful venture capital investments. These variables were developed from an examination of the annualised rate of return achieved by 50 venture capital investments, made between 1960 and 1968, on realisation of the investment (the dependent variable, 'success') and the characteristics of the investees at the time of the investment (24 independent variables). The independent variables reflected the management, marketing, financial and product characteristics of the investees. Hoban did find that the stage of product development and extensiveness of the market evaluation were positively correlated with success, whilst the proportion of equity owned by the venture capitalist was negatively correlated. Overall, however, Hoban was unsuccessful in developing this model, concluding that the variables that predicted success were too complex or too subjective to identify and measure quantitatively. (See also Hoban, 1981).

Cope Pence (1981; 1982) sought to reduce the evaluations of three hypothetical business proposals by 35 venture capitalists into three fundamental financial variables, namely risk, return and liquidity. She found that some relationship did exist between the evaluation of these variables and the overall decision to to commit resources to further investigating the proposal as an investment candidate. This was in contrast to the participants view, that their investment decisions were based on a 'gut feeling' for a proposal. Cope Pence concluded that investments by venture capitalists are based on the same analysis of fundamental

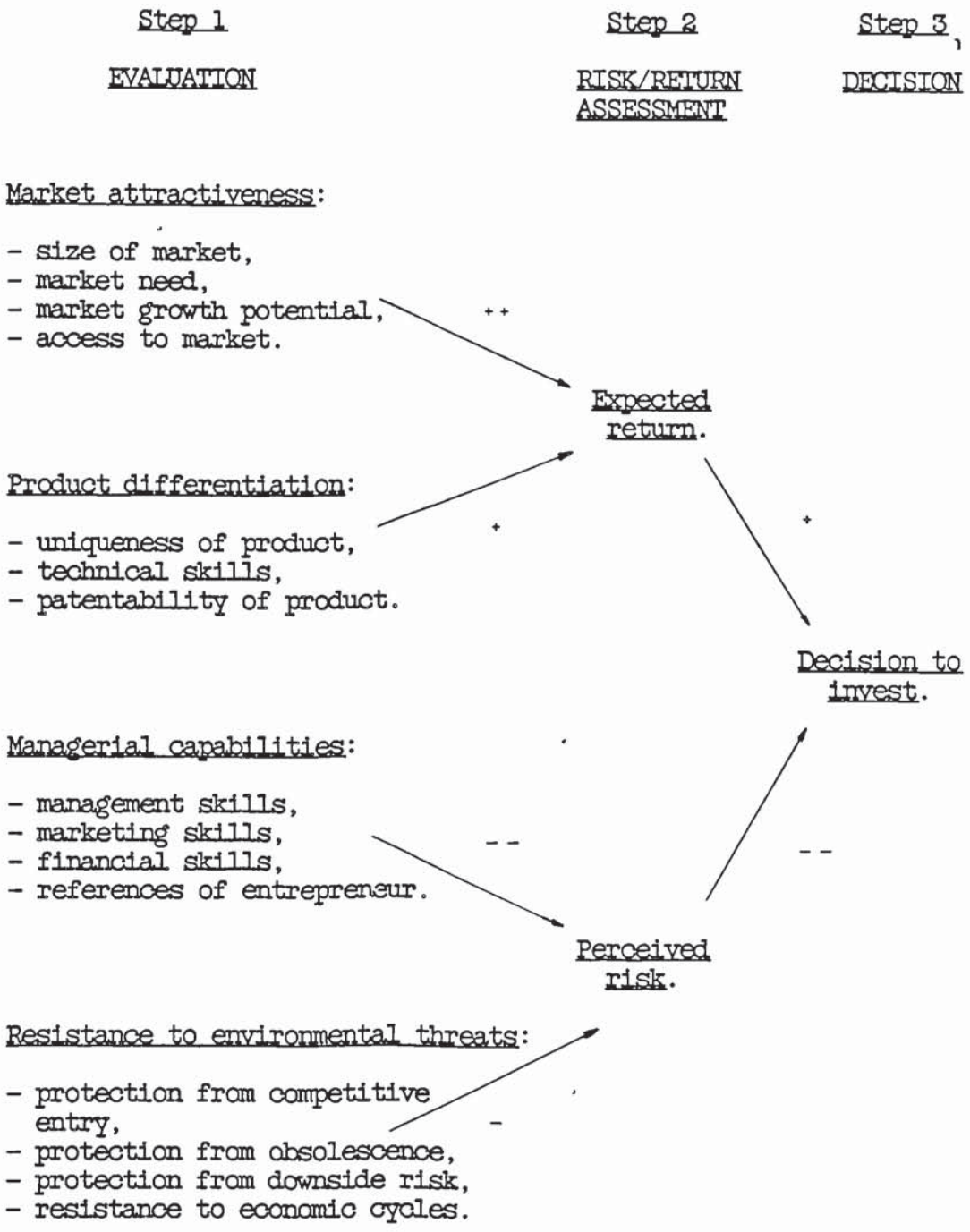
financial characteristics as other investment decisions. It is the definition of these fundamentals which makes the investment decision criteria seem different from other investment opportunities where more historical data exists.

Cope Pence's study is discussed further in sections 3 and 7 of Chapter seven.

Tyebjee and Bruno's series of studies of venture capital investment activity (Tyebjee and Bruno 1984a; 1984b) includes one which sought to identify the components of perceived risk and expected return in investment appraisal. From the assessment of 90 venture capital investments by 41 venture capitalists, factor analysis reduced 23 characteristics of these investment opportunities (shown in Appendix 4.4) to five underlying dimensions. It was shown that expected return was determined by market attractiveness and product differentiation, whereas perceived risk was determined by managerial capabilities and environmental threat resistance. A fifth factor, the time scale to realisation of the investment, did not appear in their analysis to influence the perceived risk/return ratio of the investment. The four factors combining to make up the investment decision are described more fully in figure 5.3 overleaf. (See also Tyebjee and Bruno, 1984c).

Hoffman's study of regional venture capital investment in Texas (Hoffman, 1972) sought to link the characteristics of individual venture capital investors (age, educational background, occupation and other personal experience) with their propensity to invest in new business opportunities. These opportunities took the form of six single sheet investment request summaries which were in turn based on approximately 50 investment propositions and financing memoranda which had been previously been presented to other venture capitalist investors. Hoffman found that a synthesis of factors influenced the evaluation decision but that, overall, investor-centred factors, primarily the venture capitalists' attitudes and perceptions concerning particular companies and industries, were the most critical factors in more investment decisions than any other single factor. Together with company-

Figure 5.3 The venture capital decision process.



NB - The ++, +, - and — symbols indicate the direction and magnitude of the parameters describing the relationship of the variables.

Source: Tyebjee and Bruno, 1984c:1061.

related factors - management team experience and balance plus size, extent and nature of the companies markets and competition were also cited as critical factors in determining the venture capitalists investment decisions - these findings led Hoffman to suggest that the investment decision is to a large extent subjective and behavioural rather than objective and financial

5.8 Post-Investment Activities.

It will be recalled that, in section 5.3 of this Chapter, the objective of venture capital investment was described as gaining equity stakes in small, fast growing companies and realising this investment through disposal of this equity stake at some future date. It is in this post-investment phase that venture capitalists seek to add value to their investments through on-going involvement with their investee companies. The extent to which a venture capitalist will become involved in this way distinguishes this class of investor from others. Wells (1974) found that venture capitalists spend up to half their time in post-investment activities. This can range from passive monitoring of the investee's progress to providing active management and other assistance as necessary. The degree of involvement reflects the individual venture capital fund's style and policy (Lorenz, 1985).

5.9 Summary.

The venture capitalist project evaluation procedure has a number of unique characteristics when compared with the evaluation of other investment opportunities. These are related to the type of company being invested in, which are often new and of an innovative nature. This means that the venture capitalist is faced with a considerably greater degree of uncertainty in evaluating such propositions than is the case in other areas of investment appraisal. Hence, the evaluation procedure can be seen as a process of converting this unmeasurable uncertainty into quantifiable, measurable risk. This Chapter therefore focussed on studies which have investigated the mechanisms of the evaluation procedure - the stages that successful proposals must negotiate - and attempts at understanding how the evaluation decision is

reached.

The main findings of the studies presented here are that venture capitalists concentrate on the management team when assessing proposals. This is because, particularly for early stage projects, there is often little else for the venture capitalist to evaluate. In addition, the quality of the management team is seen as the most important determinant of the future success of the business. However, studies which have attempted to investigate the nature of the evaluation decision have met with only limited success.

It will be noted that, although venture capital is perceived as a method of funding high risk, technologically-orientated businesses, the conclusions reached here indicate that the technical components of propositions are not the most important factor in the evaluation decision. For this reason, the next Chapter considers in more detail the nature of the relationship between venture capital and biotechnology.

CHAPTER SIX

THE VENTURE CAPITAL FUNDING OF NEW BIOTECHNOLOGY FIRMS IN BRITAIN

6.1 Introduction.

In preceding Chapters, it has been shown that the new biotechnology arose from the discovery of gene manipulation techniques (Chapter two) and that the early commercial exploitation of biotechnology was undertaken almost exclusively by new biotechnology firms (NBFs) in America (Chapter three). Chapter three explored in some depth the reasons why the American NBFs received the backing of venture capitalists. It was shown that, initially, financing was attracted to the NBFs largely as a consequence of media publicity given, first, to the recombinant DNA debate and, second, to the potential of interferon as an anti-cancer agent. The success of the NBFs in establishing America's lead in the commercialisation of biotechnology in turn prompted a great deal of attention from abroad, including the UK.

At this time - the late 1970s - the small firm sector in Britain was beginning to receive active encouragement after many years of neglect (Chapter four). The election of the Conservative administration in 1979 brought to power a Government committed to encouraging private sector initiatives in the development of industry through technological innovation. A key role in this process was assigned to small firms.

A combination of new firm success in developing biotechnology in America and renewed interest in the small firm sector in Britain were brought together in the 1981 White Paper on Biotechnology (Cmnd. 8177). This emphasised the role of the private sector in the exploitation of biotechnology in Britain, and the necessity of allowing market forces to dictate the way in which biotechnology should develop. The Government's role was seen as one of providing a supportive infrastructure within which this exploitation should take place. This philosophy contrasts with the more active role played by Governments in, for example, Japan and France (Sharp, 1987), where closer links were sought between Government, industry

and academia for formulating co-ordinated policies for the exploitation of biosciences research.

Delegating the commercialisation of biotechnology to the private sector and market forces brought the newly-emerging British venture capital industry into direct involvement with both the development and exploitation of Britain's biotechnology capabilities. This was so because, as was pointed out in Chapter three, fundamental and commercial research are often synonymous in biotechnology. Therefore, if the example set by American NBFs were to be emulated by their British counterparts, such firms would represent the culmination of a process of strategic development of biotechnology, that is, of fundamental, mainly research council-supported, research in the biosciences. In turn, NBFs in Britain would contribute to this process of strategic development, the case of biotechnology support services (section 9 of Chapter two) being but one example. It would appear, then, to be incumbent upon venture capitalists that they have an understanding of the technology in which they invest. As Dunnill and Rudd (1984) state:

> 'If the UK is to be successful in promoting commercial developments in biotechnology, the central and most difficult problem to overcome is that of identifying promising products and services. Without this, the promotion of advanced technology may even draw resources away from more modest but profitable activities'

This refers, of course, to project selection at all levels - from identifying and supporting basic research projects through to the commercialisation of any resulting discoveries. It is at the commercial end of the process that Britain has been the least successful, where its failure to innovate has been the most visible. The role of venture capitalists is, presumably, to provide funding for projects within the disciplines imposed by market forces within which they operate, thereby supporting the innovation process. However, as was demonstrated in Chapter five, the key determinants of evaluating investment proposals are the management and market aspects of new enterprises, with the technological aspects of such proposals being relatively less important.

In the light of this apparent contradiction, the purpose of this Chapter is to look at how venture capitalists in Britain view biotechnology as an investment opportunity. First, however, the venture capital funding of NBFs will be described.

6.2 New Biotechnology Firms in Britain.

The first British NBF was Celltech, established in June 1980 in response to a recommendation made in the Spinks report that such a firm should be created. Government backing was made available, in the form of a 50% shareholding by the NEB. This represented a departure from the Government's non-interventionist policy, made explicit in the White Paper on Biotechnology of the following year, that it was business, not Government, which bore the responsibility of developing the commercial potential of biotechnology. However, it is doubtful whether private venture capital alone would have been willing at that time to support an NBF in Britain without Government support. In any event, the fact that Celltech was set up enabled subsequent NBFs to gain funding. For example, Cambridge Life Sciences was first formed in early 1980 and received its first venture capital backing in May of the following year. As such, it was Britain's second NBF and the first to be wholly privately funded. One of its co-founders, William McCrae, wrote later:

> 'Insofar as the formation of CLS was concerned, however, Celltech was a very necessary primer of the pump. The formation of Celltech brought the potential of this new area of high technology sharply into focus in the UK for the first time and, through their experience of investing in Celltech, gave our initial supporter Technical Development Capital Limited (TDC) a sufficient background in biotechnology to understand and approve of what we were proposing to do.' (McCrae, 1983:71)

Subsequent investments by British venture capitalists in UK NBFs (table 6.1) and NBFs in other countries - almost exclusively America - (table 6.2) are shown on the following pages. It may be of interest to note that, up to October 1983, biotechnology firms represented 1% of all companies receiving venture capital backing in the UK, whilst receiving 4% of all funds (Venture Economics, personal communication).

Table 6.1 Investments made by UK venture capital firms in British new biotechnology firms to June 1986.

Key: (a) Type of venture capital firm
I = Specialist venture capital firm
II = BES scheme fund
III = Banks
IV = Organisations with Government funds
V = Fund managers
VI = Other

(b) Type of finance provided
A = Pre start-up
B = Start-up
C = Early development
D = Later development
E = Management buy-out
F = Other
G = International technology transfer

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Inveresk Research Holdings	Scottish Development Agency	IV	11/1977	D	325	29.1
Celltech	3i Ventures	I	07/1980	A	480	3.1
	Pruventure	I	11/1980	B	4,258	N/A
	Midland Bank	III	No details available.			
	BTG (NEB)	IV	N/A	N/A	2,360	15.1
	British and Commonwealth Shipping	No details available.				
	Biotechnology Investments Ltd.	III	06/1983	C	5,018	10.9

Table 6.1 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Cambridge Life Sciences	3i Ventures	I	05/1981	A	875	39.7
	British Linen Bank, Creative Capital Fund (BSS fund)	II	1981/2	B/C	25	1.0
	F&C Investment Trust plc.	I	1983	N/A	128	N/A
	Newmarket Venture Capital Ltd.	I	No details available.			
	British Linen Bank, Melville Street Investments	III	01/1984	C	533	7.2
Cruachem Holdings	Scottish Development Agency	IV	06/1981	B	206	12.5
	British Linen Bank, Second Melville Fund (BES Fund)	II	11/1985	N/A	103	6.3
	British Linen Bank, Melville Street Investments	III	01/1986	C/D	310	18.9
Imperial Biotechnology	3i Ventures	I	01/1982	A	387	33.1
	Baronsmead Associates Ltd.	I	11/1983	C	98	2.0
	F&C Enterprise Trust plc.	I	1983	N/A	90	N/A
	Newmarket Venture Capital Ltd.	I	1983	C	256	5.3
	Imperial College	N/A	N/A	N/A	N/A	25.0
Plant Science Ltd.	3i Ventures	I	07/1982	A	75	40.0
	University of Sheffield		No details available.			

Table 6.1 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Fibre Treatments	3i Ventures	I	01/1983, 11/1985	C	432	40.0
	Warburgs Investment Management	III	No details available.			
Agricultural Genetics Company	Advent Technology plc.	I	07/1983	B	504	5.0
	Advent Eurofund Ltd.	I	07/1983	B	508	5.0
	Biotechnology Investments Ltd.	III	09/1984	B	1,253	5.1
	Baring Brothers Hambrecht & Quist	I	12/1984	B	No data provided	
	F&C Enterprise Trust plc.	I	1984	B	120	N/A
	Prutec Ltd.	I	10/1985	D	523	N/A
	BTG (NRDC)	IV	N/A	N/A	N/A	22.4
IQ (Bio)	Biotechnology Investments Ltd.	III	11/1983	C	2,308	19.7
	Hambros Advanced Technology	I	N/A	N/A	200	2.9
	BTG (NRDC)	IV	N/A	N/A	N/A	11.6
	BASE International Ltd.	VI	12/1985	D	N/A	N/A
Twyford International	Biotechnology Investments Ltd.	III	11/1983	C	1,750	6.0
	Grovesnor Venture Managers Ltd.	I	11/1983	C	433	3.9
	Prutec Ltd.	I	11/1983	C	549	N/A
WMC (Resource Recovery)	Biotechnology Investments Ltd.	III	11/1983	B	1,175	38.3

Table 6.1 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Europroteins Ltd.	Advent Technology plc.	I	03/1984	C/D	100	12.5
	Advent Eurofund Ltd.	I	03/1984	C/D	100	12.5
Lodge Diagnostics	Scottish Development Agency	N/A	03/1984	N/A	105	N/A
BioTechnica Ltd.	Larpent Newton, Growth Fund	V	04/1984	B	1,800	N/A
Shield Immunologicals Ltd.	3i Ventures	I	06/1984, 05/1986	C	175	45.0
	Two Scottish investment trusts	No details available.				
Microbial Resources Ltd.	Equity Capital for Industry	I	1984	A	N/A	11.9
	Citicorp Venture Capital	I	11/1984	No details available.		
Mercia Diagnostics	Charterhouse Japhet Venture Fund	I	12/1984	E	454	40.0
	Biotechnology Investments Ltd.	III	12/1985	C	424	12.3
Plant Resources Ltd.	Equity Capital for Industry	I	1984	F	52	10.1
Ab-Ag Laboratories Ltd.	Newmarket Venture Capital Ltd.	N/A	1984	N/A	491	43.5
Biomass Ltd.	Welsh Development Agency	N/A	1984	N/A	417	10.0
Antibody Technology Ltd.	Biotechnology Investments Ltd.	III	03/1985	A	163	N/A

Table 6.1 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
International Embryos	Biotechnology Investments Ltd.	III	04/1985	C	925	19.5
Damon Biotech Europe (USA/UK subsidiary)	Advent Technology plc.	I	09/1985	G	193	0.4
	Advent Capital Ltd.	I	09/1985	N/A	719	1.5
	Transatlantic Capital Ltd.	I	09/1985	C	193	7.0
	Alan Patricof Associates Ltd.	I	1985	B	383	N/A
	Scottish Development Agency	IV	09/1985	C	387	13.5
Aquaculture Vaccines	Managed Technology Investors	I	1985	E	200	93.0
CLEAR	Venture Link	I	1985	B	833	N/A
Cambridge Research Biochemicals Ltd.	Biotechnology Investments Ltd.	III	02/1986	C	413	13.8
	Charterhouse Japhet Venture Fund	I	02/1986	C	300	13.0
	BTG (NRDC)	IV	N/A	N/A	N/A	13.0
Biotech Instruments Ltd.	BASE International Ltd.	VI	04/1986	C	N/A	N/A
British Earthworm Technology Ltd.	Cambridge Capital Expansion Fund 1985-86	II	04/1986	C	122	23.0
Efamol Ltd.	Alan Patricof Associates Ltd.	I	1986	B	280	N/A

Source: Cary, L., 'Venture Capital Report Guide to Venture Capital in the UK', 1987, and Company Annual Reports.

Table 6.2 Investments made by UK venture capital firms in foreign new biotechnology firms to June 1986.

Key: (a) Type of venture capital firm
I = Specialist venture capital firm
II = BES scheme fund
III = Banks
IV = Organisations with Government funds
V = Fund managers
VI = Other

(b) Type of finance provided
A = Pre start-up
B = Start-up
C = Early development
D = Later development
E = Management buy-out
F = Other
G = International technology transfer

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Amgen (USA)	Biotechnology Investments Ltd.	III	04/1981	B	1,208	2.1
Applied Biosystems Inc. (USA)	Biotechnology Investments Ltd.	III	09/1981	B	226	N/A
Repligen Corporation (USA)	Biotechnology Investments Ltd.	III	09/1981	B	3,013	6.7
Centocor Inc.	Newcastle Company Ltd.	N/A	1981	N/A	$187	0.2
NPI	Newcastle Company Ltd.	N/A	1981	N/A	$371	2.3
Integrated Genetics (USA)	Biotechnology Investments Ltd.	III	02/1982	C	1,400	N/A

Table 6.2 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Xoma Corporation (USA)	Advent Technology plc.	I	03/1982	G	350	2.3
	Advent Eurofund Ltd.	I	12/1982	G	489	2.6
Advanced Mineral Technologies (USA)	Biotechnology Investments Ltd.	III	05/1982	A	1,500	43.8
DNA Plant Technology (USA)	Biotechnology Investment Ltd.	III	06/1982	B	1,670	N/A
Immunex (USA)	Biotechnology Investments Ltd.	III	10/1982	C	1,290	5.3
Catalytica (USA)	Biotechnology Investments Ltd.	III	11/1982	C	2,000	10.4
CW Ventures (USA)	Biotechnology Investments Ltd.	III	11/1982	B	667	3.1
Hana Biologics	Newmarket Company Ltd.	N/A	1982	N/A	514	1.5
Applied Biotechnology Inc. (USA)	Prutec Ltd.	I	05/1983	B	643	N/A
	3i Ventures	I	11/1985	D/C	$250	3.4
	Robert Fleming	III	No details available.			
Biosearch (USA)	Prutec Ltd.	I	06/1983	C	450	N/A

Table 6.2 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Genzyme (USA)	Biotechnology Investment Ltd.	III	07/1983	C	1,500	6.1
	Advent Technology plc.	I	07/1983	C/D	417	2.8
	Advent Eurofund Ltd.	I	07/1983	C/D	415	2.8
Queue Systems (USA)	Biotechnology Investments Ltd.	III	07/1983	C	1,000	7.0
	Thompson Clive Growth Companies Fund	I	N/A	C	103	1.4
Plant Genetics (USA)	Biotechnology Investments Ltd.	III	08/1983	C	2,323	8.4
Noctech Ltd. (Eire)	Development Capital Corporation	I	11/1983	C	394	29.9
	Alta Berkeley Associates	I	12/1983	No details available.		
	Transatlantic Capital Ltd.	I	05/1986	C	90	2.0
Liposome Inc. (USA)	Alan Patricof Associates Ltd.	I	1983	B	332	N/A
Genetics Institute Inc.	Newcastle Company Ltd.	N/A	1983	N/A	$801	0.4
Vestar Research (USA)	Biotechnology Investments Ltd.	III	01/1984	C	1,750	7.8
	Newmarket Company Ltd.	N/A	1984	N/A	1,005	4.7

Table 6.2 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Acade (Belgium)	Advent Technology plc.	I	02/1984	B	175	4.4
	Advent Eurofund Ltd.	I	02/1984	B/C	174	4.4
	Biotechnology Investments Ltd.	III	10/1984	C	1,277	16.7
Synergen (USA)	Biotechnology Investments Ltd.	III	08/1984	C	500	0.9
Idetek (USA)	Biotechnolgy Investments Ltd.	III	10/1984	B	295	10.0
Ecogen (USA)	Biotechnology Investments Ltd.	III	11/1984	B	550	8.7
Quidel	Newmarket Company Ltd.	N/A	1984	N/A	$411	6.7
United Agriseeds Inc.	Newcastle Company Ltd.	N/A	1984	N/A	$424	1.4
Cytotech (USA)	Biotechnology Investments Ltd.	III	05/1985	B	1,000	9.3
	3i Ventures	I	1985	C	$ 750	5.7
Nordisk Gentofte (Denmark)	Biotechnology Investments Ltd.	III	07/1985	D	1,337	1.4
Biotrol (USA)	Biotechnology Investments Ltd.	III	07/1985	A	300	9.4
Sepracor (USA)	Biotechnology Investments Ltd.	III	07/1985	B	685	8.4

Table 6.2 (continued)

Biotechnology company	Venture capital investor(s)	Type of firm	Date finance provided	Type of finance	Amount of funding (£'000)	Equity held (%)
Immunetech Pharmaceuticals (USA)	Biotechnology Investments Ltd.	III	09/1985	C	5,097	35.9
	Advent Capital Ltd.	I	04/1986	N/A	675	6.5
Automated Microbiology Systems Inc. (USA)	Transatlantic Capital Ltd.	III	10/1985	C	178	8.0
Verax Corporation (USA)	Advent Capital Ltd.	I	04/1986	N/A	522	8.4
Dianon Systems (USA)	Biotechnology Investments Ltd.	III	06/1986	C	686	8.4

Source: Cary, L., 'Venture Capital Report Guide to Venture Capital in the UK', 1987, and Company Annual Reports.

6.3 Attitudes of British Venture Capitalists to Biotechnology.

Although the preceding tables show that a considerable amount of funding has now been invested by British venture capitalists in biotechnology, this is in marked contrast to the situation in the late 1970s. It will be recalled, from section 10 of Chapter three, that at that time considerable disquiet had begun to be expressed over Britain's apparent failure to take advantage of its strong basic research capability in the biosciences. Unlike the US, there was little evidence that either Government or industry were aware of the commercial implications of the new techniques. Of particular relevance to this thesis were comparisons being made of the strong venture capital support for American NBFs and the shortage, indeed at that time complete absence, of comparable funding in the Britain.

In the late 1970s, the UK venture capital industry was still at a rudimentary stage of development. Some academics were concerned that, because of this, many of the commercial opportunities which had gained widespread attention in America would be lost for the lack of venture capital backing. Investors responded by saying that money was available, but that the research was too under-developed and there was no guarantee of a worthwhile return on investment. Furthermore, the contemporary economic climate in Britain mitigated against funding new and uncertain technology (anon., 1979)

Given the level of support being received by American NBFs at the time, the attitude of UK investors could quite legitimately be taken, as indeed it was by the proponents of biotechnology, as confirmation that British financiers understood little of the needs of industry or small business, or issues relating to the development of new technology. The risk averse nature of the financial institutions, coupled with the apparent lack of interest in biotechnology from either Government or industry, meant that once again Britain was in the process of missing out on the commercial benefits of a technology whose creation it had been so closely involved in. Certainly, so far as European venture capitalists in general were concerned, there was some evidence that they were more risk averse than their American counterparts.

In 1978 Biogen, Europe's first NBF, was unable to raise funding from either Swiss or German backers and had had to turn to American investors in order to obtain initial backing (anon., 1980).

To what extent was this risk averse view an accurate reflection of financier's true attitudes? It should be remembered that there were (and, to a lesser extent, still are) considerable differences between America and Britain in the environment for investment in NBFs, as has been considered at some length in section 3 of Chapter three. In addition, the rDNA debate did not attain anything like the same public profile in Britain that it did in America. Therefore, the general knowledge of what biotechnology actually represented was, perhaps, not as advanced in the UK. In any case, 'conceptualising the product' in biotechnology is difficult for non-technologists. This is for a number of reasons - the recent emergence of biotechnology; the fact that prototype manufacture is often not possible and, therefore, usually an idea or technique is on offer; because the products, unlike those of, for example, the semiconductor industry, are often remote from everyday life - which all combine to make biotechnology (arguably): 'the least understood of the new technologies and also one in which marketable results are the most elusive' (Waight, 1984).

That said, the first venture capital firm specialising in biotechnology, Biotechnology Investments Ltd., was established, not in the US, but in Britain in 1982. However, the firm failed to find any suitable investment opportunities in Britain during its first 18 months of operation. Over the same period, it invested in 11 unlisted and 6 listed companies in the US. This was, Biotechnology Investments commented, largely due to the lack of any business sense on the part of UK proposers as much as shortcomings in the ideas behind the projects, which were frequently sound. The failure of any UK proposals was, therefore, because: 'To the venture capitalist product area is not a primary determinant in the allocation of funds' (anon., 1983).

The attitude expressed by Biotechnology Investments to investing in British business propositions is revealing. One of the

complaints levelled at UK financial institutions is their failure to understand the significance of technological advances. In Biotechnology Investments, we have a sector-specific venture fund set up explicitly in recognition of such a technological advance. Yet, at the same time, it is clear that the technology involved in its investee companies is not a primary determinant of this firm's investment decision. This concurs with one of the findings of Bullock's study of academic entrepreneurship in the United States, mentioned previously in section 7.3 of Chapter three, that the technical assessments of investment propositions by US venture capitalists are perfunctory (Bullock, 1983:23). It is also consistent with the findings presented in Chapter five of this thesis, that the key determinant of a venture capitalist's investment decision is the quality of the management team of a potential investee.

If this is so, then it is not so much that financiers have failed to support biotechnology but, rather, that there were indeed few viable propositions available for them to invest in. Notwithstanding the more adverse economic environment in Britain - smaller market size, less opportunity for capital gain, higher tax levels and so forth - the major reason for this was the lack of academics with the entrepreneurial skills necessary to run this type of enterprise successfully. Certainly, if academics were disparaging about the lack of interest and understanding shown by financiers in commercialising their research, then the financial community was equally jaundiced in its opinion of academics. The lack of commercially minded scientists was seen to have come about because the academic environment: 'is at best ignorant and at worst inimical to the world of industry' (Waight, 1984:21). Compared to America, British academic scientists have frequently, in the past, been reluctant to become involved in industrially-orientated research, preferring instead to concentrate on advancing fundamental knowledge which others would develop:

> 'On this side of the Atlantic, the emphasis is still largely that it is up to governments and the financial community to "pick the winners" and that the academic researcher should stand aside from this' (Bullock, 1983).

In attempt to address this problem, one of the continuing elements of science policy in the 1980s has been to make academics in Britain more aware of the commercial implications of their research. Indeed, this has largely become a matter of necessity as reductions in central Government grant funding through the research councils and the University Grants Committee has meant that academic researchers have become increasingly reliant on the industrial sponsorship of research.

But whilst reshaping attitudes in itself is difficult, producing a nucleus of academic entrepreneurs capable of managing high risk enterprises is an altogether more lengthy process. The fact that the NBFs shown in table 6.1 have been supported would indicate that such entrepreneurial talent has begun to emerge. In this respect, the Government's strategy has shown some success, although this is a long and continuing process and whether sufficient talent will be made available remains open to question.

However, it is the view of the author that arguments over whether sufficient managerial talent is available, whether the provision of venture capital is adequate, and whether British venture capitalists are more risk averse than their US counterparts, are all peripheral to the problem which venture capital-backed small firms are supposed to address. This is the notion of such firms having a central role in the technology transfer process. In policy documents on the development of biotechnology (Bull et al. 1982; OTA, 1984; ACARD/ABRC/RS, 1980); in accounts of the innovation process (Bullock, 1983); in literature on venture capital investment (Clarke, 1987; Lorenz, 1985; New Scientist, 1987); in accounts of investment in biotechnology (Fishlock, 1982; McCrae, 1982;); the relationship between venture capital and high technology is consistently reiterated. There is evidence of this relationship in the massive support given to American semiconductor and biotechnology-based new firms. Venture capital has been encouraged in Britain to emulate the American example, to overcome the historic weakness in innovation. And yet, venture capitalists invest primarily in managerial ability, not technology. This would appear to suggest that, in the absence of suitable management teams, 'the perennial UK science policy dilemma of apparently being good at inventing but bad at

exploiting' (Williams, 1987:9) is not being addressed by venture capital. As a result, the presence of a venture capital industry is not in itself an answer to the prevention of lost commercial opportunities.

In conclusion, the relationship between venture capitalism and its perceived role in funding new, innovative enterprises can be seen to be a contradictory one. This is because venture capitalists do not invest in high technology as such. The primary determinant of the investment decision is the management of the investee company. The contradiction may be explained by the industry sectors in which venture capitalists choose to invest. These are commonly perceived to be of a high risk nature, and frequently involve high technology. However, within these sectors their investment determinants are not high technology. They invest in high technology as a result of investing in a particular sector, not as a result of any intrinsic merit in the particular product being supported.

6.4 Investigating the Venture Capital-Biotechnology Interaction.

In the light of this apparent contradiction, the purpose of the remainder of this thesis is to investigate the nature of the venture capital - biotechnology interaction. In order to do so, two complementary themes will be pursued. The first of these will be to investigate, in general terms, the nature of the evaluation process. This includes how business propositions are evaluated - what items of information contained within business proposals are key to reaching the evaluation decision, and why they are seen to be so - and how and why evaluation decisions are reached. This will provide a framework for investigating the second theme of this research, which is to find what weighting or influence the technological aspects of biotechnology proposals have in reaching the investment decision. In summary, the aim of this research is to find:

(i) what items of information venture capitalists select in formulating their decision as to whether to pursue a business proposition as a potential investment candidate,

(ii) why these items are chosen for assessment by the participants, that is, why they are seen as key determinants of the evaluation decision,

(iii) what weighting is given to these items of information in reaching the decision to proceed further with the evaluation,

(iv) what degree of weighting the technological and product components of a business proposal are given in the evaluation relative to other items of information, and

(v) what perceptions are held of biotechnology as an investment opportunity - how investment in biotechnology is understood by venture capitalists - and what influence this has on their perception of the risks of, and potential rewards from, investing in biotechnology and biotechnology-related projects.

6.5 Summary.

This Chapter has drawn together the findings of the first four Chapters of this thesis and has provided an overview of the relationship between venture capital and biotechnology. It has shown that, because the primary determinants of venture capital investment are not technological, this relationship is in many respects a contradictory one. It has identified a number of key features of this relationship which will be the subject of further investigation in this study. These include how biotechnology is perceived as an investment opportunity and how venture capitalists go about evaluating biotechnology proposals as potential investment candidates. The next Chapter describes the methodology devised to investigate these issues.

CHAPTER SEVEN

DESIGN OF RESEARCH METHODOLOGY

7.1 Introduction.

When presented with a business proposal, the venture capitalist forms some view of the attractiveness of the proposal as an investment opportunity. The preceding literature review indicates that the formulation of the investment decision is essentially a three stage process. In the first stage, deal screening, the proposal is reviewed to see if it is compatible with the venture capitalists' basic investment criteria. These include the amount of finance needed, the stage of company development and the geographic location of the venture. Assuming the proposition meets these basic criteria, the second stage, deal evaluation, involves an assessment of the fundamental components of the proposition, such as management capabilities, market opportunity, financial data and product information. On the basis of this assessment, a view is formed of the risk/reward trade-off offered by the proposition, that is to say, the risk of the investment being lost against the potential reward to the investor of the company meeting its objectives. This risk/reward trade-off forms the basis for the third stage of the process, the decision whether or not to invest in the deal.

This Chapter describes the methodology devised to investigate how the assessment and evaluation procedure is applied to biotechnology projects. The main points of interest for this investigation, as described in the previous Chapter, may be summarised as follows.

(i) How proposals are evaluated - the features of the business proposal that the venture capitalist considers to be important in formulating the investment decision. Of special interest, in the context of this present research, is the degree of weighting the technological and product components of the proposal are given in the evaluation.

(ii) Why, having identified the important features of the business proposal, the venture capitalist arrives at a particular investment decision.

(iii) The perception of biotechnology as an investment opportunity - in other words, how investment in biotechnology is understood by venture capitalists. Also, what influence this has on their perception of the risks of, and potential rewards from, investing in biotechnology and biotechnology-related projects.

7.2. Investigating the Approach to Project Evaluation.

We can postulate that an individual venture capitalist's approach to an investment evaluation is governed by four basic criteria.

First, there is the external economic environment within which the venture capital company operates, which dictates the attractiveness of high risk investment strategies in any given place or time.

Second, there is the ethos of the venture capital company itself. This is reflected in the company's approach to investment and attitude to risk, as exhibited in its deal screening criteria. Equally important is the company's internal organisational structure and levels of accountability to both higher authorities within the company and to external authorities, for example shareholders or parent organisations.

Third, there is the venture capitalist's own heuristic. This may be described as a combination of the skills, experience and methods the individual brings to an evaluation, irrespective of any technological considerations. In other words, these are the skills and experience necessary for an individual to assess this type of business proposition - to be a venture capitalist.

The fourth factor, which is in fact part of the above but is treated separately here, relates specifically to investment in biotechnology. This is the individuals technological literacy. By this we mean the degree of exposure to biotechnology the individual has had either through formal expertise gained in

industry or academia, or through prior experience of evaluating or investing in biotechnology or biotechnology-related proposals.

An interview schedule was drawn up to aid detailed investigation of these points. This schedule looked at staff backgrounds and experience, general information on the type of proposals received, details of the evaluation procedure itself and attitudes to biotechnology investment. The original schedule was refined during the pilot interview stage, to take into account limitations of time available for questioning. The interview schedule reproduced in Appendix 2.1 is the version used for the actual interviews. Supplementary information on screening criteria and portfolio exposure to biotechnology was obtained from other sources, such as annual reports and guides to venture capital investment. The findings of the analysis of these interviews are presented in Chapter eight.

7.3 Investigating the Evaluation Decision.

Here, we are concerned with finding out how venture capitalists evaluate business proposals and why they reach the decisions they do. A methodology developed for an American study of investment decision-making by venture capitalists served as a model for this part the present research.

Christine Cope Pence's study: 'How Venture Capitalists Make Investment Decisions' (Cope Pence, 1982), previously described in section 7 of Chapter five, used hypothetical business proposals as a tool for obtaining comments from venture capitalists about how they evaluated investment opportunities. Cope Pence's objective was:

> '...to determine a set of factors which actually affect the investment decisions of venture capitalists who invest in early-stage innovative companies.' (Cope Pence, 1982:51)

Her study demonstrated that some relationship existed between the evaluation of a proposal's fundamental financial characteristics, defined as 'risk, return and liquidity' variables (these will be described later in section 7.7), and the venture capitalist's

decision to allocate additional resources to further evaluation of the proposal as a potential investment candidate.

Cope Pence's study used three business proposals. It was decided to only use two proposals in this present study, as it was felt that asking venture capitalists to review and discuss three proposals would be unreasonable because of the time commitment involved.

One of the Cope Pence proposals, entitled Tissue Reproductions Inc. (TRI) is reproduced in Appendix 6.2. This outlines the planned commercialisation by three surgeons of a novel substance for use in plastic surgery. Because this plan can be considered as a biotechnology or biotechnology-related proposal, it was included in this study. It was also hoped that some useful information could be gained in comparing US and UK venture capitalists' evaluation of this proposal (see section 7 of this Chapter).

The preparation of the second business proposal will now be described.

7.4 Preparation of a Hypothetical Business Proposal.

Remembering that one of the main concerns of this exercise was to find why venture capitalists make the decisions they do, the aim was to produce a proposal that only a proportion of the investors would find attractive. The assumption was that items of information contained within each proposal would determine the overall evaluation decision, and that in identifying these, the reasons why decisions are made could be identified. (This is discussed further in section 7 of this chapter.)

However, two other outcomes were also envisaged. First, it was anticipated that the proposal would be so attractive that it would elicit a universal positive response. The second, and more likely outcome, would be a plan so naive in its preparation and assumptions that it would elicit a universal negative response. The ideal proposal would be one which was as realistic as a hypothetical exercise allowed, which at the same time was attractive to only some of the investors in the study.

The initial phase of preparing the plan involved formulating a set of guidelines and assumptions around which the proposal would be constructed. In the main these related to identifying a suitable product or technology on which to base a company. The second phase involved constructing a model company around this technology and writing the business proposal. The third phase involved testing the proposal, through distributing the plan and receiving feedback as to its feasibility and viability. The stages in this development are described below.

7.4.1 The product.

Identifying a suitable product for the company consisted of three stages. First, a list of product 'concepts' (ie. the types of product which might be suitable for development by, and form the basis for, a viable small firm) was prepared. In the second stage a list of considerations governing product choice were formulated. The third stage involved identifying and selecting a product which conformed to these guidelines.

7.4.1.1 Product concepts.

(i) The technology had to be suited to development and exploitation in a small company setting.
(ii) The product had to be technologically viable.
(iii) The product should be ready for sale in a realistic time scale.
(iv) There should be an identifiable market need for the product which either already exists, or could be demonstrated to exist.

7.4.1.2 Product choice.

As a broad simplification, biotechnology can be considered as consisting of four distinct areas of activity from which products may arise. These are;

(i) recombinant DNA technologies,
(ii) monoclonal antibody technologies,
(iii) bioprocessing technologies and

(iv) enabling technologies.

From these four areas we can identify certain types of products which have commercial potential and have attracted the venture capital investor. The list is vast but, for each of the areas of activity listed above, we might consider products such as;

(i) therapeutic agents,
(ii) diagnostic agents,
(iii) separation and purification products and
(iv) control instrumentation, reagents, information services,

as typical groups of products which have been developed in venture capital-backed companies.

Finally, we can identify an order of commercialisation. On the whole, the most successful companies in terms of income derived from actual product sales have so far operated in biotechnology support services, ie. category (iv) above. In general terms, small firms operating in categories (i) to (iii) may either be in competition or collaboration with large established companies, have high costs associated with product development, or have lengthy product development timescales.

7.4.1.3 Product selection.

The instrumentation market was identified as one potentially exploitable area for a UK based biotechnology start-up company. The shortage of British-manufactured laboratory equipment, instrumentation and reagents was identified in the 1980 Spinks report (ACARD/ABRC/RS, 1980). A 1984 Science and Engineering Research Council (SERC) Biotechnology Directorate report underlined this weakness and stated:

> 'In the field of automated recombinant DNA and peptide synthesisers the USA meets little competition and this benefits American firms both directly in instrument sales and indirectly in genetic and protein-engineering developments using these instruments.' (Dunnill and Rudd, 1984:81)

A recommendation of this report was that the Government should take a more active role in providing research funding to develop a UK manufacturing capability in biotechnology equipment and instrumentation (Dunnill and Rudd, 1984:3).

Identifying an instrument which fulfilled both these product concept and product choice criteria was unexpectedly easy, as such a product was found to actually exist. The 1984 SERC Directory of Research in Biotechnology identified a grant-supported project at the University of Manchester Institute of Science and Technology (UMIST) involved in the development of an automated DNA sequencer (SERC, 1984:103). The Department of Instrumentation and Analytical Science at UMIST was contacted and it was found that the sequencer had been developed and was ready for commercialisation. A paper published in Bio/Technology described the technical features of the instrument (Martin et al, 1985) and an article in the Economist describing a parallel development in America outlined its commercial potential (anon., 1985).

It was clear that the DNA sequencer would be an ideal basis for the model company. The instrument existed; in real life it was at the stage of commercial development; a market need could be demonstrated; it was an enabling technology suited to small company development; automation of this type of procedure had already been demonstrated through the commercial development of similar types of equipment, such as automated DNA and peptide synthesisers, in the US, Germany and Japan; and finally, it fitted a need identified by biotechnologists in the UK and could be reasonably espoused as an important contributor to the development of an indigenous instrumentation capability. From the technological point of view, the need for such an instrument could be amply demonstrated.

7.4.2 The company.

Placing the product on a commercial setting was more difficult as, unlike the product, no model existed in the UK which could be used to directly authenticate the type of company which might undertake the commercialisation of such a development. At the time of preparing the proposal, only Celltech Ltd. and Cambridge Research

Biochemicals Ltd. were producing related equipment, namely semi-automated DNA and peptide synthesisers. Neither company had been set up to specifically manufacture equipment of this type.

As a first step, a set of underlying assumptions were formulated to provide guidelines for the eventual form of the business. These were:

(i) the management team should should be able to demonstrate that they have the relevant technical and commercial expertise required to develop the product;
(ii) the company should be able to demonstrate some track record of success in the instrumentation market;
(iii) the DNA sequencer (as in the case of UMIST's instrument) should be at the stage where commercial development was possible;
(iv) the amount of finance required should be above the lower limits of venture capital financing (around £200,000) but below the level where syndication was necessary;
(v) the company should be able to demonstrate an ability to achieve an adequate return on investment within a reasonable period of time;
(vi) the company should be based in the UK.

It was felt that, without these basic assumptions underlying the preparation of the plan, venture capitalists would be unlikely to be interested in the proposal.

As a second step, two guides to business plan preparation (Arthur Young, 1984, Ormerod and Burns, 1985) were obtained in order to find what type of information the business proposal should contain. The key items of information were identified as:

(i) Summary/overview of the proposal;
(ii) Contents list;
(iii) Description and history of the company and its proposed development;
(iv) The product, including a technical description and its function;

(v) Market analysis and marketing, including sales activities and information on competitors;

(vi) Manufacturing and operations;

(vii) Management and ownership of the company;

(viii) Personnel and company structure;

(ix) Financial data;

(x) Use of funds;

(xi) Appendices, including management c.v's.

The business proposal, entitled Brookfield Instruments Ltd. (BIL), is presented in Appendix 6.1.

7.5 Testing the proposals.

Before being dispatched to the venture capitalists participating in the study, the BIL proposal was reviewed initially by three members of the University staff - an accountant, a corporate financier and a chemical engineer. After making alterations based on their comments, the proposal was reviewed by a management accountant. After further modifications, the plan was evaluated by a venture capitalist. A final version of the plan was then evaluated by three more venture capitalists in a set of pilot interviews. These final interviews did not reveal any need for further modifications to the plans and, subsequently, these evaluations were found to be suitable for use in the study.

Although the TRI proposal had been used in the US study and was reproduced as it appeared in Cope Pence's thesis, it was decided that the proposal should be subjected to the same test procedure. The two alterations made as a result of this were to include figures in pounds sterling, as well as dollars, and to convert the accounts into a UK format. The accounts in their original US format were retained as an appendix in the distributed proposal. Advice was sought on whether the figures needed to be updated to take into account inflation between 1979 and 1985, but the consensus was that this was unnecessary. Furthermore, doing so would have meant that the amount of financing required by TRI would have exceeded some participants non-syndicated maximum funding limits. In summary, no major problems in the presentation,

format or content of the TRI plan were highlighted in the pilot study.

Therefore, upon completion of the pilot study it appeared that both proposals were acceptable, and that they were not so naive as to be rejected out of hand on the basis of poor presentation or because of erroneous assumptions underpinning their preparation.

7.6 Selecting the participants.

In selecting venture capital firms to which the proposals were to be sent, the primary concern was identifying those companies who had invested, or wished to invest, in biotechnology or biotechnology-related businesses.

In addition, the following selection criteria were adopted:

(i) the venture capitalists should be willing to invest in start-up companies;
(ii) their minimum funding levels should be around £200,000;
(iii) because the TRI proposal was being used, they would invest in US companies.

In practice, this last condition was to prove the most difficult to satisfy.

On the basis of these criteria, 51 venture capital firms were selected from four guides to sources of venture capital (Pratt and Lloyd, 1985; anon., 1985; Stoy Hayward, 1985; BVCA, 1985). They were contacted by letter in August and September of 1985, prior to the preparation of the BIL business proposal. 27 indicated they would be willing to participate in the study, 21 declined to do so and 3 did not reply. For those declining to participate, the main reasons given were lack of expertise or interest specific to biotechnology, lack of interest in investing in start-up companies and the time commitment required for the project.

Preparing the BIL proposal proved to be far more difficult than had been anticipated. Composing a document which, hopefully, would appear authentic and yet which was entirely hypothetical meant a

considerable time commitment in terms of background research, writing and re-drafting. Pilot-testing both proposals involved additional delays. For these reasons, the proposals were not ready for review by the participants until Easter of 1986. By the time the first interviews had been arranged for May, three participants had withdrawn because of staff changes and three more were unable to evaluate the proposals because of work commitments, although they were willing to discuss their approach to biotechnology investment. The fund characteristics of the remaining 24 participants are shown in the following tables (tables 7.1 to 7.6). The source for all the tables is the Guide to European Venture Capital Sources (Pratt and Lloyd, 1985).

Table 7.1 Relevant industrial sector preferences.

Sector	No. expressing preference
Genetic engineering	15
Medical/health related	21
Biotechnology	3
Instrumentation	21
No sector preference	2
Number with investments in biotechnology	13

Table 7.2 Stage of funding undertaken.

Stage of funding	No. expressing preference
R&D/Seedcorn	8
Start-up/ early stage	24
Expansion/ development	23

Table 7.3 Minimum funding levels.

Amount (£)	No. expressing preference
Below 100 000	4
100 000 - 200 000	17
250 000 and above	3

Table 7.4 Geographical limitations.

Area	No. expressing preference
UK and USA	14
UK specific funds:	
general	7
regional	3

Table 7.5 Type of firm.

Type of firm	No. of firms
Subsidiaries:	
clearing bank	2
investment institution	5
Independent funds	13
Public sector funds	3
Investment advisors	1

Table 7.6 Year founded.

Year	No. of firms
Prior to 1970	4
1970 - 1974	3
1975 - 1979	6
1980 - present	11

When dispatching the two proposals it was recognised that, particularly in the case of TRI, the plans might not meet the participant's deal screening criteria. Therefore, a covering letter requested that the plans be evaluated both in the light of and independently of these criteria. This was so that an evaluation of the opportunity offered by each proposal could be obtained even though the venture capitalist under normal circumstances would not actually undertake such an evaluation. The covering letter, together with a list of firms participating in the study, is reproduced in Appendix 3.

It must also be borne in mind that the participants were not expected to state whether they would actually invest in either proposal. To expect a venture capitalist to make such a commitment on the basis of a proposal alone was clearly unreasonable, given that an investment decision is made over a period of weeks as a result of negotiating with the entrepreneur. This study allows us to look only at the deal screening and preliminary evaluation stages of the investment process, when the decision to proceed with the evaluation is formulated.

Interviews of approximately two hours duration were conducted in the venture capitalists' offices between May and September 1986. The interviews were taped and later transcribed prior to further analysis. In all, 21 evaluations of both proposals were obtained, two of these by letter. 23 interviews on evaluation procedures and perceptions of biotechnology were also obtained. (One participant who evaluated the plans by letter was not available for interview).

Part of the agreement with the participants was that their identities would remain confidential, in order that any comments made could not be ascribed to any particular individual. For this reason, they were randomly assigned an identifying number, from 01 to 24. These numbers are used to identify the participants in the data analysis Chapters 8,9,10 and 11 which follow.

7.7 Evaluating Venture Capitalists' Comments on the Business Proposals.

In Cope Pence's study, the researcher had prepared a list of general areas to explore during her interviews with the venture capitalists who had undertaken an evaluation of the business proposals. These areas were (a) personnel, (b) product, (c) exit opportunity, (d) capitalisation, (e) timing and (f) gross margins (Cope Pence, 1982:24).

The interview comments were scored post-interview under 21 categories, each category being scored from -2 (unfavourably evaluated) to +2 (favourably evaluated). This scoresheet is reproduced in full in Appendix 2.2. These 21 categories were reduced to three variables - risk, return on investment and liquidity - representing the fundamental financial characteristics of the proposals. Assignment of the categories to each variable is shown in table 7.7 below. A mean score for the risk, return and liquidity variables was obtained by summing the scores given for the categories within each variable, and dividing by the total number of categories for which a score was available.

Table 7.7 Assignment of interview comments to risk, return and liquidity variables.

	Category	Variables		
		Risk	Return	Liquidity
1.	Value to the world	*		
2.	Demand growth	*		
3.	Availability of substitutes		*	
4.	Price elasticity	*		
5.	Technological characteristics	*		
6.	Marketing and advertising strategies	*		
7.	Product liability	*		
8.	Government regulations	*		
9.	Research and development commitments		*	
10.	Market size		*	
11.	Distribution system		*	
12.	Margins			*
13.	Years to maturity			*
14.	Capital needed	*		
15.	Percentage of market			*
16.	Exit potential			*
17.	Market barriers		*	
18.	Profit and loss experience	*		
19.	Technical knowledge	*		
20.	Management commitment	*		
21.	Management team experience	*		
Total categories in each variable		12	5	4

Source: Christine Cope Pence, 'How Venture Capitalists Make Investment Decisions' (Cope Pence, 1984:25).

The approach taken in the present study was to ask the venture capitalists for their overall evaluation of each proposal and what factors they had taken into account in reaching their decision. The aim was to find what they themselves considered to be the important elements in the evaluation. This was so the relationship between the technological component of the proposals and other factors taken into account in reaching the evaluation decision could be investigated. For this reason, no formal interview schedule was drawn up. It was felt that that the use of a pre-determined interview schedule would focus their responses, which would be inappropriate for the purposes of this study. The responses obtained through the use of such a format would inevitably be biased towards the interviewer's interests and might have obscured the items of information that individual participants found relevant to their evaluation.

Following their description of the evaluation of each proposal, the venture capitalists were requested to score the proposals on an evaluation rating scoresheet consisting of three scales (reproduced in Appendix 2.3). The first, a 1 to 5 scale devised by Cope Pence, described their overall evaluation of each proposal. On this rating, a score of 1 indicated that the proposal would not be considered, that it would be rejected immediately. A score of 5 indicated that the proposal was of great interest and would be likely to receive funding. Recognising that either proposal could be rejected on the basis of deal screening criteria alone, a second 1 to 4 scale sought to identify the reason why a proposal had been given a score of 1 on the first scale (indicating immediate rejection); that is, whether the proposal was rejected on screening criteria, or simply because it was fundamentally unattractive to the investor. The third scale indicated the level of attractiveness of the proposal in terms of its presentation and layout relative to other proposals.

In addition, the participants were asked to fill in Cope Pence's 21 category scoresheet (Appendix 2.2). This was done for three reasons:

(i) to provide the participants with the opportunity to evaluate the proposals in a numerical as well as a verbal sense;
(ii) to obtain a comparison between the US and UK evaluations of the TRI proposal (ie. by comparing scores given for TRI in the US with those given for TRI in the UK) and
(iii) it was intended that the interviewer would complete the scoresheets post-interview from the interviewee's comments (much as Cope Pence had done), to see to what extent the interviewer's interpretation of the venture capitalists' comments reflected their actual evaluation of the proposals.

The development of the analysis of the venture capitalists comments on both proposals is described in Chapter nine. The analysis of the Cope Pence scoresheet is presented in Chapter ten. First, however, the next Chapter presents a survey of venture capitalists evaluation procedures.

CHAPTER EIGHT

VENTURE CAPITALIST PROJECT ASSESSMENT AND EVALUATION.

8.1 Introduction.

We have postulated that the way in which biotechnology and biotechnology-related proposals are evaluated is determined by four factors:

(i) the external economic environment within which the venture capital firm operates,
(ii) the evaluator's personal experience and skills,
(iii) the internal structure, organisation and accountability of the venture capital firm and
(iv) the evaluator's level of technological literacy.

The external economic environment within which venture capital operates has already been partly described in the establishment of venture capital firms in Britain. Venture capital investment is particularly sensitive to tax legislation and the ability to realise capital gains. Other influences on day to day investment, for example the trend to invest, or avoid investing in, certain types of project on the basis of current fashion have also been covered to a limited extent in describing the biotechnology hype of the early 1980s in the US. Therefore, this particular aspect of venture capital investment was not considered in the interviews conducted in this study.

Instead, the Chapter presents the results of the semi-structured interview conducted with the participants (see questionnaires presented in section 1 of Appendix 2). It is intended to provide a comprehensive survey of the way in which venture capitalists evaluate proposals and the influences which impinge upon their evaluation. The framework for the presentation which follows is that of the format for a 'typical' project assessment, from the time a business proposal is first received until the decision to commit funds is reached. The participant's perceptions of biotechnology as an investment opportunity will then be discussed.

The aim of this chapter is to provide a commentary for the analysis and interpretation of venture capitalist's comments on the two business proposals which will be presented in the following chapters.

First however the qualifications and experience of the participants will be described.

8.2 Qualifications and Experience of Interviewees.

In all, 23 interviews were conducted. At 18 of these, one person was present, at the remainder, two. Their levels in the company hierarchy, academic and professional qualifications, employment experience and experience in venture capital are summarised in tables 8.1 to 8.4 which follow.

Table 8.1 Levels of seniority of interviewees.

Level	Number
Director	5
Senior executive	17
Junior executive	6
Total	28

Table 8.2 Academic and professional qualifications of participants.

(i) Academic qualifications.

Discipline	Number
Science degrees, biotechnology related	5
Science degrees, non-biotechnology related	3
Social sciences/arts degrees	3
Masters of Business Administration (MBA)	4
PhD (biotechnology related)	2
Not stated	11

(ii) Professional qualifications.

Accountants (chartered and certified)	11

Table 8.3 Employment experience.

Sector	Number
Financial/commerce only	16
Industry	8
Biotechnology related (academic/industry)	4
Total	28

Table 8.4 Length of time with current employer.

Years	Number
1	2
1.5	2
2	5
2.5	2
3	4
5	4
6	2
Not stated	6
Total	28

8.3 The Evaluation Procedure.

The following description of the assessment and evaluation process is a composite drawn from interview transcripts. It focusses on the area of interest of this thesis, namely the deal screening and early evaluation stages of the assessment process. The degree to which any one firm conforms to the procedures described of course varies. Where relevant, areas of difference are discussed.

8.3.1 Initial contact with the venture capitalist.

An initial approach to the venture capitalist may be direct from the entrepreneur or via intermediaries. The first approach is often by telephone. Assuming the intermediary is a reliable source of proposals, the venture capitalist will only be informed of plans that are likely to be of interest. In having the plan described over the telephone, the venture capitalist is able to determine if the plan meets the basic screening criteria and portfolio requirements of his company.

A written business plan received in this way has therefore already received a preliminary screening. In any event, a plan received at the office will receive a fairly rapid read through, perhaps lasting half to one hour. This will determine or confirm whether the proposal meets the venture capitalist's deal screening criteria and portfolio requirements and whether the proposal is fundamentally interesting.

8.3.2 Number of proposals received each year.

The number of business proposals received each year by participants in the study varied from under 100 for a specialist biotechnology investment fund to over 1000 for a high profile publicly funded organisation. These figures do not include telephone contacts or other casual contacts with intermediaries. The numbers received are shown in table 8.5 below.

Table 8.5 Total number of business proposals received each year by participants in this study.

Number of proposals received	Number of venture capitalists
under 100	1
100 - 249	4
250 - 400	13
over 400	6

The average number of proposals received by the participants was slightly less than 400.

8.3.3 Source of proposals.

The source of plans was found to depend to a large extent on the organisational structure and profile of the company. For independent companies, the major source of deals were intermediaries, particularly accountants, and other venture capitalists. If the plan was from another venture capitalist, either it had been referred, because it had not met that company's screening criteria, or the venture capitalist in question would be seeking syndication partners.

Whilst these sources were also important for subsidiary companies (ie. divisions of investment or financial institutions), the dominant source here was the parent organisation, which usually had a higher profile than its venture/development capital division.

Direct contacts from entrepreneurs in the above two cases were reported to be around 10%. For publicly-funded companies, the level of direct contact from entrepreneurs was much higher. Correspondingly, their rejection rates were much higher.

Because of (a) the diversity of sources, (b) the differing types of company in this survey and (c) the fact that few participants monitor sources of proposals, there is no universally representative breakdown of sources applicable to any one company. The responses shown in table 8.6 were reported at interview.

Table 8.6 Sources of proposals for venture capitalists.

Parent company/organisation.
Other investment institutions (including other venture capital firms), including those looking for syndicate partners.
Clearing banks.
Accountants.
Other intermediaries and professional advisors (including lawyers, brokers and management consultants).
Personal contacts (the 'old boy network').
Direct contact from entrepreneurs.

8.3.4 Effect of source of proposal on evaluation.

The source of the proposal was found to be important in affecting its evaluation. As was mentioned above, if the plan had been referred from a reliable source, its applicability to the venture capitalist's particular deal screening criteria would already have been judged, as would its fundamental attractiveness. It was stated that the source of the plan could affect the seriousness with which the proposal is reviewed, with a deal originating from a reliable source being taken more seriously than one received as a cold call:

> [The source of the proposal] '... governs how the proposal will be treated. In other words, if we've confidence in the source, we'll treat the proposition more seriously than if it comes through the post from someone we've never heard of.'
>
> Venture capitalist 02.

One source of proposals which drew particular comment were those referred by accountants. Accountants have adopted a high profile as intermediaries in venture capital and opinions on their role in the investment process were sharply polarised.

In all instances, the venture capitalists preferred plans which had been written by the management team, with the help of professional advice as necessary. On the whole, such plans were regarded the most favourably.

Two of the participants welcomed proposals prepared with the assistance of, and referred by, accountants as they tended to follow a standard format, address the main areas of interest and conform to a minimum standard of presentation. These venture capitalists favoured such proposals as they obviated the need to extensively restructure the business plan.

In contrast, surprisingly vehement comments were made by a number of other interviewees about plans which accountants had assisted the management team in preparing. This criticism no doubt also applied to others specialising in the preparation of business plans for management teams, but as previously stated, accountants have adopted a particularly high profile in this.

To some, given that they considered business proposals on the whole to be poorly prepared, plans prepared by or with the assistance of accountants were perceived to be no better or worse than those prepared independently by the entrepreneur. For others, such a plan would be scrutinised far more rigorously or even rejected out of hand. Two main problems were identified. First, such plans were seen to be biased towards the provision of excessive amounts of financial data, the underlying assumptions of which had often not been worked through or fully considered. Furthermore, accountants were seen to be in a position of "dressing up" the data to fit whatever assumptions were deemed

necessary for the presentation of the document. Second, the entrepreneur was often found to have little understanding of the information, particularly financial information, put into the plan by the accountant. The view taken by these participants was that accountants were involved in venture capital primarily to derive income from business plan preparation and audit fees. In summary, these venture capitalists saw their own role as adding value to the investment through on-going involvement with the investee company, whilst accountants were involved "just for the money".

The following quote illustrates this point well.

> 'One of the biggest problems is deciding if they've written the plan or if it's been written for them. Early on, we have to resolve this question. There are a lot of parasites around who will write these plans and do very good jobs. But when you actually address the plan you realise the people you're talking to aren't actually familiar with it. This is a very big major negative factor. One of the big tests of funding a business ... you're happy that the people are going to be running the business for you. You have maybe one meeting a month, the other 29 days it'll be in their hands. If they've a weakness in, for example, the financial area, and they're using advisors and using advice properly, we wouldn't knock it. But they should at least understand it. But in many instances one gets voluminous paperwork run off ... at [a major accounting firm] because they've said that's what banks want.
>
> ... [At technical conferences] 'you find a very high proportion of accountants - to get their foot in the door, to do business plans to get funding, leading to auditing and special work, therefore a lot of accountants and quasi-accountants are keen to structure these deals ... [but] accountants are number crunchers who believe their role is to take verbals from entrepreneurs and convert them into understandable spreadsheets - they don't go in for querying the underlying assumptions too much, and become hostile if assumptions are challenged - they just say they can re-run it with these new assumptions.'
>
> Venture capitalist 05.

8.3.5 Reasons for an initial rejection.

The plan may be rejected at this early stage in the evaluation for the reasons outlined above, ie. screening or portfolio requirements, or for other reasons. It was found in the pilot study that venture capitalists will often approach an evaluation

from a certain perspective, in that they will chose to look at one particular aspect of the deal which it is believed underpins the rest of the evaluation. In the evaluators view, if this key factor is not present or is not believed then the rest of the deal will be undermined irrespective of whatever other merits the proposal may possess.

This factor (or factors) in effect represent a bias in the individual venture capitalist's approach to evaluating a project. It would appear that these biases relate to both the individual evaluator's experience and the venture capital company's ethos. For example, if an evaluator's prior experience was in a marketing function, marketing was stated as the most important factor in the early stage evaluation. Similarly, if the evaluator was financially or technically orientated, then the financial or technical aspects of the plan were highlighted as the most important items determining whether the plan should be investigated further. Likewise, if the venture capital company was strongly proactive, the absence of a full management team would not prevent the proposal being further investigated provided other aspects of the plan were attractive. For less proactive funds, the absence of a full management team would be sufficient for the proposal to be rejected regardless of any technical or marketing merits it might possess.

The two quotes which follow illustrate contrasting evaluation biases.

> 'The biggest problem we have is inadequate management teams, particularly on the early stage things ... It's very rare for an early stage company to have an adequate management team. In many cases it's a critical problem as far as our funding of the business goes - we don't do it ... [This is] the biggest single reason for rejection even if everything else is OK. You need a team - one person isn't good enough.'
>
> Venture capitalist 07.

> 'Again, [this venture capital firm] is unusual in that it isn't over-concerned with the strength of the existing management team. A lot of venture capitalists will, in effect, back people. Unless they've a belief in the founder and his team, no matter how good the product is, they'll shy away from investing in it. We take the reverse view. Providing the technology and

> market looks right, because of our proactive style we believe we can find the management to make it all work. We're one of the very few. A number of funds claim to be interested in high tech but, having evaluated the product, still rely on a strong management team to develop the business, so as venture capitalists they spend little time with the business, providing guidance only, whereas we actually work with the business.'
>
> Venture capitalist 10.

We can consider that the existence of bias in the evaluation of early stage projects is related to the largely subjective component of the exercise. For example, although the potential financial reward of investing in a proposal can be assessed and subjected to sensitivity analysis, the degree of confidence in a financial forecast is only as good as the information put into constructing the forecast. We can, therefore, postulate that if financial information is selected or identified as an evaluation bias, the evaluator is putting a degree of confidence into these forecasts which another evaluator would be reluctant to do. In addition, the factor identified is the one which he or she perceives is easiest to assess. If the evaluator has a technical background, or experience of the technology in question, they feel far more comfortable in assessing the technical potential of the proposal than someone trained in financial or marketing disciplines.

We can, therefore, regard the existence of evaluation bias as a second level of deal screening, for the rapid identification of projects for more detailed evaluation.

Analysing the comments on bias presents some problems. In some cases, only one factor was mentioned as the primary factor in the evaluation, whilst others presented factors in ranked order. Several reported factors with no order of preference. Furthermore, some factors were reported as not being important at this early stage. Table 8.7 on the next page presents the primary and secondary evaluation biases mentioned by interviewees. Three or more factors were included in the no bias (ie. all factors equally important) category.

Table 8.7 Early stage evaluation biases of participants.

Category	Mentioned as important		Mentioned as not important
	Primary importance	Secondary importance	
Management	9	3	3 (a)
Marketing	3	4	
Financials	3	2	1 (b)
Technology	3	1	3 (c)
No bias	5		
Total	23		

(a) Indicated that they would complete a management team.
(b) Indicated lack of confidence in financial projections.
(c) Indicated evaluation would take too long/technology not understood.

It must be stressed that this refers only to the early stage of the evaluation process. For a project to receive funding, all facets of the company would be investigated. As one interviewee said:

> 'In our evaluation, people (the management) are the most important factor - but it's no good backing good people in a poor market with a lousy product.'
> Venture capitalist 15.

Another reason for rejection may be that the venture capitalist has in his portfolio of investments or prior investment experience some knowledge which indicates a weakness in some element of the proposal.

The rejection may be based on more subjective criteria. Although an outstanding opportunity will (obviously) always be followed up, a borderline case (ie. a plan which lacks some fundamental characteristic, such as a complete management team) will often only be pursued if the venture capitalist's workload is light enough to allow for the extra time needed to evaluate the proposal and bring the company to the stage where it is a viable investment proposition. If the venture capitalist's workload is heavy, borderline cases are far more likely to be rejected. Some

interviewees indicated that borderline plans would be set aside until time allowed for a proper evaluation.

8.3.6 The business proposal in the evaluation procedure.

Finally, it was stated by some interviewees that the plan could be rejected if it was not well written or presented. However, this was by no means a generally held view. Opinions on the importance of business proposals in the evaluation process varied considerably, as apparently did the quality and presentation of the proposals. It was indicated by five participants that if a business opportunity was seen to be exceptional, a very poor business plan or even the absence of a plan would not necessarily mean they would lose interest. For this group, business plans were only important insofar as they demonstrated that the entrepreneur could write a business proposal.

However, most venture capitalists in the study preferred to see a proposal as soon as possible. This group saw the plan as a selling document which required sufficient effort in its preparation to coherently explain the company's plans and objectives - a document which would get the management team to an interview with the financier. The content and presentation of the plan was seen as an indication of the quality of the management team.

In size, proposals varied from one or two pages to 'an enormous document'. Their quality likewise varied, but this appeared to be related to the following factors.

(i) Business proposals prepared by companies in their first attempt to raise finance were generally regarded as the poorest in terms of information content and presentation.
(ii) The standard of proposals which had previously been presented to another venture capitalist and had been rejected, and those from businesses seeking later rounds of financing, were generally higher.
(iii) The standard of presentation has improved in recent years, and the reason why is clear. It is only within the last decade that this method of raising finance has become so widespread. Consequently, there were few guides to the

construction of business proposals. Now, because demand for this information has made professional guidance on business plan preparation more widely available, general standards of presentation have increased and many proposals are complete in their basic information.

In all instances, preference for a short, concise document was expressed.

8.3.7 External sources of advice.

During this initial read-through, particularly with technologically-orientated proposals, the first contact with an external source of advice will often be made to confirm in general terms that what is said about the product is true. This could either be with a portfolio company in a related area, informally through a contact in academia or industry, or if appropriate, with someone with sector expertise in a parent or affiliated organisation. The contact will invariably be in the venture capitalist's network of informal information sources.

Throughout the evaluation procedure, as much of the assessment as possible will be done in-house. If specialist in-house knowledge does not exist, the venture capitalist will have to turn to outside sources for help. However, the types of outside advice used are strictly limited. For certain aspects of the evaluation, for example in the preparation of an accountants report and legal documentation relating to the deal, formal external sources have to be used. In all other instances, the venture capitalist will seek to use informal sources, usually acquaintances or colleagues working in relevant areas. If more formal reports on the management, market or product are required, for example if the deal is to be syndicated, these will not be obtained until late in the evaluation process, because of their expense.

8.3.8 Evaluating technical aspects of the deal.

Although some of the funds visited did have technically qualified people in the evaluation team, it was considered by venture firms without such in-house expertise - the majority of the participants

- that technical knowledge would rapidly get out of date. Furthermore, these funds stated that the venture capitalist could not be expected to be technically proficient in all areas. Instead, time-served experience of evaluating such projects coupled with contacts in academia and industry was seen to be a more realistic approach to evaluating high technology deals. The possibility of missing an opportunity through lack of technical expertise was not therefore seen as a problem.

8.3.9 Formality of assessment.

In an preliminary interview at Aston Science Park (which has its own in-house venture fund) in connection with this study, it was found that a 'formalised' method of project assessment, involving the use of standardised checklists, was used. The idea was to attempt to reduce the influence of individual bias in the preliminary evaluation of proposals by introducing a degree of standardisation to the assessment procedure.

In this study, only three participants used any kind of checklist in their evaluation. In the first instance, a screening form was filled in for each incoming proposal, for comments to be made on various aspects of the proposal, such as the industrial sector, personnel, financial performance, current and proposed investors, amount of finance required and recommendations for further action.

In the second case, two 'investment criteria' forms were used, one being an expanded form of the other. Each consisted of a list of questions on the status of the business, its profit potential, management, funding requirements, products, marketing, manufacturing and relation to deal screening criteria. Each question was accompanied by a yes/no answer. Any 'no' automatically rejected the proposal:

> '[It developed] in an attempt to take the subjective feeling out of the process. There's always a danger one pushes the businesses one likes and rejects those one has a natural inclination not to like. What we've tried to do is continuously refine our criteria, so we all have a very clear understanding of what we want to invest in, and we try and convey that to the referers - the accountants, the solicitors, other venture capitalists and so forth ... having a clear definition

> of the criteria, having a way of objectively measuring propositions against that criteria is important, it takes out the personal feelings.'
>
> Venture capitalist 08.

In the third case the checklist was not made available at interview, but from its description it appears to be similar to the second checklist described above.

The degree of formalisation in other companies varied. In five cases, it was indicated that a report would be written on each proposal, justifying the accept/reject decision. However, the idea of a formal checklist in the early stages of the evaluation was dismissed, either because the diversity of business opportunities covered made standardisation impractical, or because the interviewee had insufficient time to construct a workable checklist.

8.3.10 Meeting the entrepreneurs.

If the plan is of interest, the venture capitalist will aim to arrange a meeting with the management of the business within one to two weeks. On the basis of a brief revue of the business plan, the venture capitalist will have prepared a number of questions on aspects of the plan relevant to his or her evaluation. The entrepreneur may be contacted by telephone to clarify certain key points or to request that further information be sent on the proposal prior to the first meeting. Before meeting the entrepreneurs the venture capitalist will already have embarked on the preliminary phases of the evaluation process.

In most instances, venture capitalists indicated that they preferred the first meeting to be at the entrepreneur's business premises, if these existed. However, this was not always practicable. Some venture capitalists preferred to meet at their offices. The initial meeting could last anything from one half-hour to a full day.

The objective of this first meeting is to decide whether the proposal should have resources committed to it for a more detailed evaluation. As the venture capitalist will already have decided

that the plan looks interesting, this decision is based on two aspects relating to the meeting. The first is to put the business plan in context, to clarify and expand on the assumptions underpinning the business. The second is to meet and assess the management of the company. A vital part of the venture capital investment process is the building up of a rapport between the investor and the investee, particularly for proactive funds who will be involved on a regular basis in the running of the company. The venture capitalist must also be convinced that the management team of the company have a good relationship between themselves and can demonstrate their commitment to the success of the business.

8.3.11 Rejection of deals through the evaluation process.

Rejection rates of deals at each stage in the evaluation process were found to relate to the total number of deals received, which in turn depended on the public profile and technological specificity of the venture capital firm.

The reasons for rejecting proposals evolve during the evaluation procedure. Initially the reasons for rejection are either deal screening criteria, a proposal which 'doesn't appeal', or a fundamentally naive proposal. The percentage of deals rejected on deal screening criteria and/or initial reaction to the business plan (ie without meeting the entrepreneur) varied between 20% and 95% of the total number of proposals received. (These figures exclude rejected telephone contacts.) The average figure for all interviewees was 55%. By implication, a proportion of plans which met the venture capitalists deal screening criteria did not meet some fundamental business criteria, so it is difficult to say how many plans are rejected on screening criteria alone. Some participants mentioned that for exceptional opportunities, their deal screening criteria were flexible. For example, a development capital firm may occasionally invest in a start-up company.

After the initial meeting with the entrepreneurs around 50% of the remaining proposals are rejected. The major reason for rejection was stated to be inadequacy in the management team. To what extent this was due to failure in building up a rapport is uncertain - it

is probably a combination of this and a failure to agree on target terms which would establish ground-rules for, and hence justify, a more detailed evaluation. Target terms would include the amount of equity that may have to be relinquished, the timing and amount of funding and the period to realisation. It should also of course be pointed out that the entrepreneurs may reject the venture capitalist.

As in the case of analysing responses on evaluation biases, the reasons for rejecting proposals varied considerably. In order of frequency, the reasons cited are shown in table 8.8 below.

Table 8.8 Reasons for rejecting business proposals.

1. Screening criteria.

2. Managerial capabilities:

   - weakness of management
   - no previous business experience
   - no complete management team
   - management too technologically orientated
   - weak financial management
   - rapport with management.

3. Financials:

   - level of funding required (tendency to fewer, larger investments)
   - growth potential of business
   - profit potential of business (returns too low)
   - exit criteria (lead time for investment)
   - negotiating terms for deal, including relinquishing equity
   - pricing of deal.

4. Sales and marketing:

   - size of market
   - market opportunity.

5. Product:

   - technology not unique, product not defensible
   - portfolio exposure
   - no follow-on products (one-product companies).

We can account for the reasoning behind the rejection of proposals at this stage by the fact that the meeting would not have taken place had the venture capitalist not been sufficiently impressed

by the fundamentals of the proposal as outlined in the business plan. However, no doubt in a proportion of cases other reasons than those outlined in table 8.8 pertain in deciding to terminate the evaluation at this point.

In the case of an initial rejection, ie. on deal screening grounds, the decision will often be taken by one member of the evaluation staff. This is often the chief executive, but may be another member of the team delegated to screen incoming proposals and distribute them to other members with appropriate expertise. However, once the proposal has reached the initial meeting, any decision on whether to proceed with the evaluation or reject the project will usually be discussed with colleagues. The discussion will often centre on a short one or two page summary of the business and the opportunity it represents to the investor. Any decision to proceed with an evaluation has to be unanimous.

8.3.12 The evaluation in detail.

In general, after the first meeting with the entrepreneurs the detailed evaluation of the project will commence. Between one in five and one in ten of the proposals which are investigated in the detailed evaluation will be invested in. Venture capitalists aim to reach a decision on whether to conduct a fuller investigation within two weeks of receiving the proposal. If the decision is to proceed, a detailed assessment and evaluation of the proposal lasting on average four weeks is undertaken. The time taken and number of people involved in this depends on the nature and complexity of the company being evaluated and the type of funding it is seeking. In some cases one person would run with the deal, in others two people will be involved. In all instances, it was indicated that other colleagues in the venture capital organisation would be kept in touch with the stage of progression and status of the evaluation and be consulted as necessary.

In the second stage of the evaluation, the fundamental aspects of the deal will be examined in considerable detail. Due diligence will be carried out to establish the credentials of the business as a legal entity. Customer and personal references will be obtained. In the later stages of the evaluation outside reports,

either formal or informal, will be obtained. Formally commissioned consultants reports are rare and will only be sought when the venture capitalist is (a) lacking access to expertise through informal contacts and (b) is satisfied that in other respects the proposition represents a potential investment candidate.

If the deal is to be syndicated, potential partners will now be approached.

8.3.13 Finalising the deal.

At the end of this stage, provided the senior investment executive(s) of the venture capital company agree, the entrepreneurs will be presented with a set of terms and conditions for the investment. If accepted, legal aspects of the deal are negotiated. At the end of this period a formal document is presented to the fund's investment board for final agreement on investing in the business.

Providing that the evaluation is straightforward, the venture capitalist will expect to commit funding to the project within 10 to 12 weeks. Table 8.9 shows a representative timetable for the time taken over the evaluation process.

Table 8.9 Timetable for the evaluation procedure.

Week 1.	Initial contact with entrepreneur (phone call/business proposal)
Week 2.	Meeting with entrepreneur.
Weeks 3-6.	Evaluation of the proposal.
Weeks 7-9/10-11.	Organising legal documentation for financing.
Week 11/12.	Finance committed.

The time required for evaluating a proposal varied according to the status of the proposal at the time it was received. In one instance a venture capitalist reported funding a project in 7 days. Others reported timescales of 9 months or more. Assuming everything is in place, a good average was reported as 3 months.

We can infer that the time taken for entrepreneurs to obtain funding for their projects is substantially longer. It is rare for a proposal, particularly an early stage proposal, to receive funding the first time it is presented to a venture capitalist. A proposal may be rejected at any stage in the evaluation process, necessitating a fresh approach to a new backer and re-entry into the evaluation process.

8.3.14 Investment strike rate.

The number of proposals which receive funding each year again varies enormously, depending on the size, structure and profile of the fund in question. A value of 1-2% of all proposals received appears typical.

8.3.15 Summary.

The information obtained in this survey confirms that found in the studies described in Chapter 5. In its format, therefore, the evaluation procedures used by British venture capitalists are analogous to those of their American counterparts.

8.4 Perceptions of Biotechnology as an Investment Opportunity.

Having established the general background to the evaluation of proposals, the attitude venture capitalists have towards biotechnology as an investment opportunity was now investigated. Because of time constraints, the influences which have helped form these perceptions could not be adequately questioned. Of particular interest was the hypothesis that the controversy over genetic engineering in the mid-1970s had been instrumental in bringing the potential biotechnology offered to a wider audience, including the investment community. To adequately investigate this would have required an interview solely directed towards this question. In this study, it was only possible to find out what attitudes were, not what had shaped these attitudes.

8.4.1 Venture capitalist's exposure to biotechnology proposals.

It was felt that the way in which biotechnology was perceived could be related to the experience the venture capitalist had had of either evaluating or investing in biotechnology projects. Even given the broadest definition of biotechnology (taking into account proposals for businesses in medical/health related, equipment, reagents and agriculture-related fields) the number of proposals received from this sector only exceeded 5% of the total number of propositions received each year in five cases. In two of these cases, the venture capitalists were specialist investors in this sector and their propositions were exclusively biotechnology related. In three other cases the venture capital firm had a biotechnology specialist in-house.

The presence of these specialist funds may account for the relatively small proportion of biotechnology-related proposals received by general funds in this study. However, from the interview data it is not possible to identify the total number of biotechnology-related proposals being generated in the UK each year and what proportion of these are directed through intermediaries to the specialist funds. Furthermore, proposals received by the specialist funds included a high proportion from overseas, particularly the US.

In terms of portfolio exposure, 13 of the 24 venture capital firms in the study had an investment in one or more biotechnology-related projects. Apart from the two specialist funds, portfolio exposure both as a percentage of total number of investments made and as a percentage of total capital invested exceeded 5% in only one case.

8.4.2 Biotechnology as an investment opportunity.

Investment in biotechnology appears to be governed, no less than investment in other high technology areas, by the investors perception of the risk-reward trade-off offered by the investment opportunity. As one of the newer high technologies, there is some track record of successful investment realisation in biotechnology. Hence, as the technology has become established, a

realisation has emerged amongst investors that big opportunities exist for the right product. However, much of the venture capital community's view of biotechnology remains grounded on the relatively volatile performance of firms currently operating in biotechnology and projections of their future growth and prospects.

It is not surprising, therefore, that all but four of the interviewees viewed biotechnology with some degree of caution. The main influence shaping this attitude appears to be the observation that, although there have been a few occasions when the returns from investing in biotechnology have been enormous, these cases were exceptional. Often, biotechnology proposals were seen to be high risk without commensurate rewards to compensate. This was exacerbated by many deals being over-priced, reflecting a more speculative American investment climate. Investing in biotechnology was compared to pharmaceutical development, where a large investment was required to get returns many years hence. From this perspective, biotechnology was seen to be not really suitable for the venture capital investor, such investments being more like R&D ventures.

This was borne out by one investor's experience of investing in a biotechnology project:

> 'We put money into biotech about two years ago and haven't since ... it's at one end of the risk-return profile in many ways. The appeal at the time was general - there are cycles [of investment] and you get sucked into the cycle ... we don't do them anymore and why we did was purely [because] we were attracted by the ... potential high returns without really evaluating the risks involved.'
>
> Venture capitalist C3.

In this instance, the investee had turned out, from the venture capitalists perspective, to be product not market orientated. The market for the product had turned out to be half the size of that originally anticipated. The product had taken twice as long to develop as originally planned and as a consequence both the amount of time and resources required to develop the project had been underestimated. The same interviewee, along with several others, also noted the conservatism of product end-users, particularly in

pharmaceuticals, as another problem associated with biotechnology investment not encountered in other investments.

That said, all companies interviewed who had no investments in biotechnology (11 in all) stated that they would like to have such an investment to give them some portfolio exposure in this sector. Regarding the question of biotechnology investment being risky, 6 of these interviewees saw biotechnology as being no more risky than other high technology sectors:

> '... whilst biotech might be regarded as high risk, other areas in which we invest are also high risk. We are investing private and institutional money. The investors are looking for a substantial return on their investment and providing we can negotiate satisfactory investment terms which will yield a high return (50% or more IRR) - providing the deal on paper yields more than that, it's irrelevant what industry. - we'd make the investment ... Therefore, there's no real difference between biotechnology and other investments.'
>
> Venture capitalist 08.

All recognised that as the technology had become established, there were big opportunities for the 'right' product (ie taking a broader definition of biotechnology to include projects with a shorter payback). In other words, there was sufficient experience in terms of a track record of success, mostly, it must be said, from the experience of small companies in America, to show that high returns could be earned from investment in this area, making the area potentially attractive to the venture capital investor. Not surprisingly, the problem was seen to be that of identifying the right opportunity - a problem, it must be said, for the investor irrespective of the industrial sector. To what extent the difficulty of market size applies in other sectors was not discussed at interview, but it was stated that the small size of the UK market, together with the difficulties encountered by small companies trying to compete in American markets - the dominant one for biotechnology products - acted as a disincentive to invest in otherwise promising proposals. One venture capitalist stated that projects had to demonstrate that they could be profitable solely in the UK market. Given the specialisation of many biotechnology products and the relatively small size of British (and European)

markets relative to the US market, this would appear to be a major problem for the start-up company in Britain.

Those interviewees with qualifications or considerable experience in biotechnology had a different perception of the potential offered and the risks required to gain these rewards. One of these summed up the way in which biotechnology is perceived rather well, by relating the question to the 'tangibility' of biotechnology. In other sectors invested in by venture capitalists, there was some concept of what the product was. For example, a proposal dealing with a new software package can be understood in relation to software packages the venture capitalist already uses. However, there is nothing familiar and everyday that 'DNA' or 'protein' can be related to. Thus, while many interviewees stated that their knowledge of biotechnology was no worse than that of any other high technology sector, that although biotechnology wasn't fully understood it wasn't unique in that respect, this ability to relate new products to those encountered in everyday life probably influences perceptions of biotechnology considerably.

The way in which biotechnology investment was regarded by those with considerable experience is represented by the following:

> '[Biotechnology is] a fundamental technology, a series of scientific and technological breakthroughs which are going to have a major impact. Whether in five years or twenty years from now really isn't the point; everybody recognises the implication of the breakthrough and venture capitalists want to get in at the beginning. Therefore, even if it takes ten years for the implications to be fully realised, by that time other people will be aware and we'll get our money back regardless of whether products are available in the marketplace. So it's a question of supporting early stage investments until products look as though they'll break through.'
>
> Venture capitalist 09.

The attitude was, therefore, that biotechnology will make money, and unless they were involved in companies at an early stage, they would not be amongst those making huge returns when biotechnology comes of age.

8.4.3 Does biotechnology differ from other investment opportunities?

In terms of comparing investment in biotechnology with investment in other areas, the major differences noted were the length of lead times involved (the period for which the investment must be held before it is realised) and the status of biotechnology's development.

Although biotechnology is not unique in having long lead times on investment - indeed, for investment in enabling technologies such as instrumentation and reagents lead times can be quite short - the time for which the investment had to be held was the major perceived problem with biotechnology investment. As a consequence, the time and resources required to get a project off the ground were often underestimated. The case of in vivo pharmaceuticals and diagnostics illustrates this point well. Regulatory and legislative issues mean that it can take between 8 to 10 years for a product to reach the marketplace. Once on the market, the end users - the clinicians - are extremely conservative. So it may be many years before such projects become established.

The status of biotechnology's development relates to the academic -industry link in commercialising biotechnology. Very often the projects that participants saw were linked to grant funded university or polytechnic research. This type of company was seen as being research not market orientated, looking for venture funds for product development rather than for commercialising fully developed products. This academic link was further commented on in terms of the generally poorer commercial management of biotechnology ventures - 'academics aren't businessmen' - and problems encountered in negotiating the deal, particularly in relation to relinquishing equity. In short, academics associated with biotechnology ventures were mostly seen as lacking the entrepreneurial flair necessary for successfully managing start up ventures.

8.4.4 Management or technology?

It will be remembered that one of the issues which influenced this research was the generally held view that Britain is poor at commercialising research and how appropriate or successful the new approach, of venture capital supported small firms, could be in developing biotechnology. Both this survey and the literature review presented in Chapter 5 have shown that, in assessing projects, venture capitalists rely heavily on the quality of the management team when deciding to invest in a company. However, it has also been indicated, in Chapter 6, that there is a lack of academic entrepreneurial talent to manage these enterprises. It was felt that venture capitalists would, therefore, from time to time encounter projects which, whilst being technologically attractive, were not viable as business propositions due to weaknesses in management team structures. Given that venture capitalists have become identified so strongly with the development of high technology, it was of interest to see how they dealt with these proposals.

With three exceptions, the participants indicated that they would not, or would only very rarely, become involved in constructing a management team for a promising company. The reasons cited were;

(i) it was not seen as the venture capitalists job to do this,
(ii) the lack of entrepreneurial talent made locating potential management too difficult,
(iii) constructing a management team was seen as too time consuming given the small size of venture fund's management teams and their other time commitments (from screening proposals to post investment monitoring).

Often the reason given for rejecting such proposals was that the academic/entrepreneur had approached the venture capitalist too early, before product development had been completed (as outlined in section 8.4.3). In these instances, the motivation of the academic/entrepreneur could clearly be called into question, given that what was being sought was essentially an extension to grant funding.

However, in other instances (where the company could be considered a start-up) the strategies adopted were either to refer the proposal to a more suitable source of funding, namely a venture capitalist who would construct a management team, referral to an existing portfolio company in a related area to see if they would be interested in commercialising the project either alone or as a joint venture, or suggest that the entrepreneur approaches a major that may be interested in taking the project on board.

The three exceptions, who would back a venture if the technology and marketing looked promising, indicated that they were prepared to assist the lead entrepreneur(s) in constructing a management team, providing the entrepreneurs (often R&D orientated) were prepared to relinquish managerial control to a more business orientated person. All three stated that they were highly proactive in their relationship with their portfolio companies. One indicated they would spend a day or more per week with a client company if necessary. This interviewee also indicated that, because of this extra time commitment, their technological appraisal was more stringent than other venture firms and consequently their investment strike rate was, in his judgement, lower.

8.4.5 Summary.

It is clear from these comments that the majority of interviewees back people rather than technology. Since the venture capitalist's primary requirement is a viable, successful enterprise, this strategy is understandable given that 90% of business failures are accounted for by poor management. But it is important to note that this commercial discipline is directed towards developing new businesses, not the development of new technology. The two may often be synonymous, but it is apparent that promising new ideas may not be supported due to lack of management expertise (or other factors, such as the small size of the domestic market). It then becomes necessary to rely on other agencies to develop the project, such as another venture capitalist or a relevant industrialist. The assumption of course is that such an agency exists to take the project on board.

CHAPTER NINE

ANALYSIS OF VENTURE CAPITALISTS EVALUATIONS OF THE BROOKFIELD INSTRUMENTS LTD. AND TISSUE REPRODUCTIONS INC. BUSINESS PROPOSALS

9.1 Introduction.

This Chapter looks at the evaluation of the Brookfield Instruments Ltd. (BIL) and Tissue Reproductions Inc. (TRI) business proposals by venture capitalists who participated in this study. It will be recalled that the participants were required to reach a decision as to whether they would proceed with the evaluation of the two proposals as potential investment candidates, or whether they would reject the proposals immediately. They were then asked to describe what factors they had taken into consideration in reaching their decision. This Chapter presents an analysis of their comments.

The purpose of the analysis was to answer the following questions:

1. What items of information do venture capitalists select in formulating their decision as to whether to pursue a business proposition as a potential investment candidate?
2. What judgements were formed on these items of information - were they evaluated positively or negatively?
3. What weighting was given to these items of information in reaching their decision to proceed further with the evaluation?
4. What were the principal determinants of the overall early stage evaluation decision, that is, can the overall accept/reject decision be linked to the positive or negative evaluation of items of information within the proposal?
5. How do the technological components of the proposal rank in the overall evaluation?

In all, 21 evaluations of the two proposals were obtained, of which two were by letter. For one of these a follow-up interview was arranged. In addition, 16 evaluation rating scoresheets (appendix 2.2) were completed for BIL and 14 for TRI. These

represent, in effect, a second evaluation of the proposals and an analysis of these scoresheets is presented in Chapter ten.

9.2 Overall Evaluation of the Proposals.

As a first measure of the venture capitalists interest in each proposal, a preference evaluation rating (Appendix 2.3) was completed by the participants. This consisted of a five point scale where:

1 = proposal would not be considered;

2 = proposal would be worth a couple of phone calls;

3 = proposal would be reviewed more carefully and phone calls made;

4 = proposal would be actively pursued as a strong investment candidate;

5 = proposal would be likely to receive funding.

If either proposal was given a score of 1 or 2 it was apparent that it was of no or little interest to the investor. A score of three indicated that they were at least prepared to consider it further, that it elicited sufficient interest to make preliminary enquiries worthwhile. If these enquiries were promising then the proposal would be more actively investigated. A score of 4 or 5 for either proposal indicated that the investor found something in the document alone which was sufficiently attractive for them to commit themselves to a more active investigation of the deal.

Table 9.1 on the next page displays the venture capitalists responses to each proposal on this evaluation scale.

Table 9.1 Evaluation responses.

Evaluation	Proposal BIL No.	BIL Freq.	TRI No.	TRI Freq.
1	4	19.0	12	57.2
2	5	23.8	7	33.3
3	11	52.4	0	0
4	1	4.8	2	9.5
5	0	0	0	0
	21*	100.0	21*	100.0

*Includes one score derived from written evaluation of proposal.

Where a proposal was scored 1, indicating immediate rejection, the responses shown in table 9.2 were reported.

Table 9.2 Reasons for immediate rejection of proposal.

	Proposal BIL	TRI
Although the plan was interesting in itself, it does not meet portfolio or other requirements.	1	4
There are major inherent shortcomings in the project which make it an unattractive investment proposition.	3	6
A combination of both these factors.	0	2
	4	12

9.2.1 Interpretation.

It is apparent that BIL received a higher evaluation overall than TRI, with 12 participants expressing some degree of interest in the proposition against just 2 for TRI. However, it must be borne in mind that of the 20 participants completing these score sheets, 9 indicated that they would not invest in US based proposals. It may be, therefore, that had TRI been a UK-based proposal - and consequently more accessible to this group of investors - more of the participants would have been willing to investigate the deal further than the evaluation ratings for TRI would appear to

suggest. Seen even as a promising proposal, the geographical remoteness of TRI may have meant that the participants were deterred from pursuing the evaluation further. (If the analysis of comments made on the evaluation of TRI proves that this proposal was viewed as a comparable investment opportunity to that presented by BIL, then this will almost certainly be the case.)

If this is so, that being an American proposal deterred further investigation, then it may be that the 2 participants who indicated interest in TRI as an investment candidate gave the proposal this higher evaluation score in recognition of the difficulties involved in further evaluating the deal. Similarly, we could explain the relatively large number of participants who gave BIL an intermediate evaluation as expressing a degree of interest which could easily be substantiated at little cost, either financially or in terms of time spent in preliminary investigation. Seen in these terms, further investigation of BIL would require a lower level decision to that required for the further investigation of TRI.

Excepting the participants who gave the proposals an overall evaluation rating of 4 (1 for BIL, 2 for TRI), it appears that neither plan was viewed with anything more than mild interest by the participants. Table 9.3 on the next page displays the reaction of participants to the business proposals in terms of their presentation relative to business proposals typically received. This shows that 12 participants thought TRI a poor or below average proposal, against just 4 for BIL, suggesting that TRI actually was seen as the poorer of the two. If the 'quality' of the proposals can be linked to the evaluation given, this would suggest that the proposition put forward above, that had TRI been a UK-based proposal it would have been more favourably evaluated, seem questionable.

Table 9.3 Rating of proposals relative to 'real life' business proposals.*

	Proposal	
	BIL	TRI
Poor	0	1
Below average	3	9
Average	11	8
Above average	7	2
Good	0	1
	21	21

*As this study progressed, it became apparent that this question was ambiguously worded, as it could be taken to mean representativeness in terms of either presentation as a document or opportunity as an investment. This ambiguity was not revealed in pilot testing of the questionnaire.

Table 9.4 below compares the overall evaluation score given for each proposal (table 9.1) with the rating given to each proposal relative to 'real life' proposals (table 9.3). The trends in the data do tend to suggest that presentation and overall evaluation were related, although the small number of cases available preclude any further investigation of the significance of this relationship. Therefore, whether poor presentation caused poor evaluation cannot be stated.

Table 9.4 Influence of presentation of business plan on overall evaluation of proposal.

(i) Brookfield Instruments Ltd.

Evaluation	Poor	Below average	Average	Above average	Good
1		1	3		
2		2	2	1	
3		1	5	5	
4				1	

... continued

Table 9.4 (continued)

(ii) Tissue Reproductions Inc.

Evaluation	Poor	Below average	Average	Above average	Good
1	1	6	4	1	
2		3	3	1	
3					
4			1		1

(iii) Combined totals collapsed.

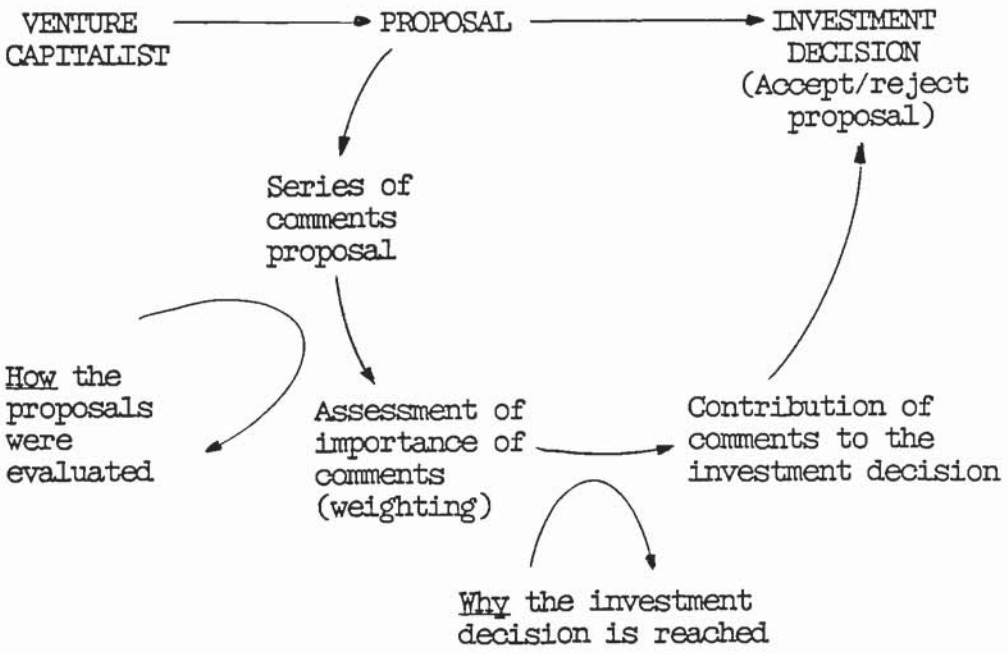
Evaluation	Poor/ Below Average	Average	Above Average/ Good	
1	8	7	1	16
2	5	5	2	12
3/4	1	6	7	14
	14	18	10	42

In summary, the evidence from these score sheets suggests a mixed response but, overall, one which was 'average' - neither completely dismissive, nor wildly enthusiastic. It may be that this is because the propositions are fundamentally naive because they are hypothetical. Alternatively, it could also be that, at best, they are only mildly attractive investment opportunities, comparable to other mildly attractive investment opportunities. The analysis of the comments made on the two proposals which follows seeks to identify the reasons why they received this response.

9.3 Framework for the Analysis.

It will be recalled that the evaluation of the two proposals involved the participants identifying items of information contained within each proposal which were of interest to them. The model adopted for the analysis of the comments they made in doing so is shown in figure 9.1 on the next page.

Figure 9.1 Model for analysis of venture capitalists comments.



The assumption of the analytical framework presented in this model is that an analysis of the comments made on the proposals can lead to an understanding of how and why the evaluation decision is reached. The aim, therefore, is to identify what items of information are assessed in reaching the evaluation decision, how they are evaluated (favourably or otherwise) and to identify causal relationships, if any, between the assessment of these items of information and the overall evaluation decision.

Before proceeding to analyse the evaluation of the two proposals, it seems worth restating the original aim of the interview format adopted. This was to find what the venture capitalists themselves considered to be the important items of information contained in each proposal, those items of information contributing to their evaluation decision. For this reason, no formal interview schedule was drawn up to discuss any particular aspect of the proposal; it was intended that the venture capitalists would describe their evaluation with no reference to the interviewer. In practise, this 'neutral observer' stance was untenable. The interviewees frequently sought clarification of, or comment on, certain items of information contained within each proposal and, as a result, a brief discussion ensued. Furthermore, after a number of interviews

had been completed, certain themes (for example, whether or not the technical information in the proposal was easy to understand) began to recur. Therefore, in later interviews, when the participants had reviewed each proposal, their opinion on these themes was solicited in order to gain further insight into the evaluation process.

9.4 Comparison to 'Real Life' Cases and Overall Impressions of the Evaluations.

Following each interview, a transcript of the venture capitalists' comments on each proposal was prepared. From the comments made it was apparent that, in general terms, the two proposals were comparable with plans typically received by the participants.

> 'Biotech plans tend to follow a similar format to these [BIL and TRI] - they're about par for the course I'd say ... As a broad overview they're both reasonably constituted plans'.
>
> Venture capitalist 02.

> 'In terms of layout both plans are pretty good really, relative to some of the ones we see'.
>
> Venture capitalist 03.

Specific comments on the format of the proposals focussed, in the main, on the summaries provided:

> [Commenting on BIL]: 'I like to see a fairly punchy summary, not only in terms of what the company's about, size of the company, where the markets lie. The summary is a bit product orientated and I haven't got a feel for what you're trying to achieve in this particular business. For busy venture capitalists you have to hand it to them on a plate. Here, on the first page: "This business has such-and-such a profit profile ... sales profile in years one to five' ... it gives a feel of what size the business is - is it sufficiently large for me to be interested?
>
> Venture capitalist 02.

> [Commenting on BIL]: 'As far as the plan is concerned and the writing thereof, the summary was pretty inadequate; if the summary isn't adequate, the chances of a plan getting any attention are quite small ... [the summary] needs to be more complete. It needs to have some indication of the projections of the business, its ultimate potential and any other products

that are going to follow on. The summary has got to be a pretty good selling sheet.'

[Commenting on TRI]: 'There's no executive summary focussing on key parts of the business, the opportunities, the scale, the returns and so forth - and that's an absolute must.'

Venture capitalist 08.

Although attempts had been made during the preparation of the BIL proposal to keep it as brief and concise as possible, it was clear that this objective had only been partially achieved, as the following comment from venture capitalist 15 indicates.

'Too large a plan [BIL] isn't a turn off - I do read them from cover to cover as I don't wish to miss an opportunity - but the entrepreneur should have been able to present it in a form which wasn't so painful to read ... [this proposal] isn't punchy enough and is quite hard to work through.'

Another feature of both proposals which prompted considerable comment was the financial information. It was apparent that in neither case did this meet the requirements of the participants. For example, as venture capitalist 01 commented:

'One of the biggest complaints was that neither was looked at from an investors point of view. They both showed that the product or service was a viable one, but they didn't show the funding structure [of the company] and didn't look at the way the investor could exit and realise their investment - they didn't provide figures to indicate what rate of return we could expect. Banks tend to look at figures and if the figures are correct - could we get a certain return out of a certain number of years - it would be impossible to find this out from this plan (TRI). But that's not unusual - a lot of people do that, plans don't seem to be written with the right information.'

[Commenting on BIL] 'There's no description of the exit route ... [neither] of these plans has been produced as a financial package - there's no indication of the amount of equity or the amount of loan capital - that they expect the investor to hold such-and-such of the company equity. They talk about; 'We want so much money, we'll talk about equity and exits later'. Therefore, it's very hard to evaluate how you'd get the money back.'

For BIL, subjects which provoked the most concern related to the company's plans to manufacture the DNA sequencer and the potential

market size for the product. In the former case, comment centred on the reasons why BIL wanted to change from their existing sales and marketing operation and enter manufacturing, and the ability of the management team to achieve this change. For TRI, equivalent issues were the regulatory requirements associated with the product, and belief in the product. Quite simply, a number of participants did not believe the product was possible, and this had an adverse effect on their evaluations. For example:

> 'It [TRI] looked a nice little wind-up ... the idea - cloned cartilage - seemed such a far-fetched concept that I wasn't prepared to take it seriously. If it was supposed to be a genuine attempt to develop a technology that had some credibility it failed - whoever wrote it didn't achieve that. I thought it was a joke - that's a criticism of whoever wrote it in the first place. If they were trying to get something that had some sort of commercial viability about it - the thing just didn't hang together.'
>
> Venture capitalist 02.

> 'Is [TRI] a total con?!' ... I don't believe any of this.'
>
> Venture capitalist 10.

Additional factors influencing the evaluation of TRI were the geographic location of the enterprise and the stage of company development, both of which are deal screening criteria.

In preparing the BIL proposal, a mixture of fact and fiction had been used. Obviously, BIL itself and the specific details relating to the company's composition were fictitious. In addition, for example, some of the companies cited as potential customers would not actually use the DNA sequencer. This was commented on by three of the participants. Further examples include the fact that Southampton Polytechnic does not exist. In only one case was it stated that this mixture of fact and fiction had caused confusion in the evaluation.

The decision to use this 'fact and fiction' approach to preparing the BIL proposal was taken in order to avoid any possible confusion with the sequencer then under development at UMIST. With hindsight, the use of fictitious companies, Polytechnics and so forth should have been avoided as it did not enhance the

credibility of the proposal. That so few of the participants noted or mentioned this is surprising although, in the final analysis, the plan was hypothetical and perhaps they took this into account.

Indeed, although the two proposals were rated 'average' in terms of their presentation and format, the general reaction to the two proposals as investment opportunities, and the interpretation of items of information contained in each, showed considerable variance. Broadly speaking, three types of responses can be identified; those in favour of, or critical of, both proposals and those favourable towards one proposal and critical of the other. The following sections provide examples of these reactions.

9.4.1 Examples of favourable comments on the proposals.

> 'Certainly ... Brookfield Instruments ... is the sort of plan we would hope would fall on to our desks reasonably regularly - it's the sort of plan which would cause [us] to read more than page one ... a well constituted, 'let's talk' type plan.'
>
> Venture capitalist 05.

> 'A well presented plan [BIL], seemed comprehensive ... to a layman it was reasonably convincing, grabs the attention, makes sense. It grabs the attention on page one - that's important if you've got a lot of plans to read.'
>
> Venture capitalist 21.

> '... it was an above average plan [TRI] for us to receive in terms of its general presentation, the way it approaches what I'd consider to be the relevant issues ...'
>
> Venture capitalist 14.

9.4.2 Examples of unfavourable comments on the proposals.

> '[My] general impression [of BIL is that] it comes over quite well as a document, it's been carefully prepared. But to some extent business plans have to be selling documents - not hyping it [the idea] up, but grabbing the interest of the investor and making him feel there's something special. It must catch the attention early on. This doesn't quite do that. It doesn't summarise the opportunity crisply at the beginning ... So I thought that it was well put together, but it's inevitably a bit thin and it's not high in interest and

excitement; it doesn't hit you between the eyes and make you think you must find out more.'

'[TRI] is a different style. It does summarise the opportunity a little bit better [than BIL] ... [but] it really does feel as though it's been written by someone who's done it as a hypothetical exercise ... but that's inevitable when you get people - students if you like - trying to do this. They just don't have the background.'

Venture capitalist 16.

'I read the plans on the basis that ... they'd just come through the door and what I would look for and how I would react to them ... [for BIL] what was touched on was totally correct and what I expected to see ... [but] It just wasn't convincing - that was the real problem. I couldn't pin it down to any one thing in particular, but there were so many areas of naivity - in fact the plan was very naive.'

Venture capitalist 17.

9.4.3 Examples of comparisons of the two proposals.

'The whole tone of the plan [TRI] is unprofessional in terms of a business slant; it's not written with the same depth of understanding of the business that [BIL is] written like. Therefore [TRI] has no come-ons for us at all. It's easy to have empathy with [BIL], whereas with [TRI] it's so far removed from reality in terms of ever running a business where you expect surgeons to hand over the money for a piece of skin and take all the risks it won't work. It all sounds so unreal - it's the sort of thing we'd laugh over ... Brookfield Instruments we could get on and fund. Tissue Reproductions would be found in the annals of amusement.'

Venture capitalist 05.

'[TRI] is worse than the other one [the BIL proposal] - it's much more towards naivity; just not commercial enough.'

Venture capitalist 08.

'My overall view on [BIL] - my gut feel - was that it was a somewhat naive presentation ... [for TRI] the whole thrust is that it's been written by a much more capable team ... I thought this [TRI] was a very much better presented plan [than BIL] ... the points they cover and the way in which they cover them whets the appetite. It goes to the other end of the scale of naivity [from] the [BIL] plan.'

Venture capitalist 20.

9.4.4 Perceptions of the technological components of the proposals.

That a number of the participants found the product being promoted in the TRI proposal unbelievable has already been mentioned in this section. Given that TRI had been reviewed quite favourably by US venture capitalists (see Chapter ten, section 4 for further details of the US evaluation), such a negative response was a surprise. However, there were proponents of the technology in TRI as well.

The differing evaluations of the products in the two proposals may be accounted for by two factors. First, as this section has shown, interpretations of the same item of information and the degree of emphasis placed on these interpretations differs from one individual to another. Second, these differences may at least in part be explained by the technological literacy of the evaluator. Compare, for example, the following comments made concerning the technical explanation of the DNA sequencer contained in BIL. Earlier in the interviews, venture capitalist 01 professed to not understanding the technical aspects of proposals and that, in any case, the product was not central to formulating the evaluation decision. In contrast, venture capitalist 02 stated that the products technical edge was essential to a successful evaluation. Another difference was that this participant had some experience of evaluating biotechnology proposals.

> 'I'd get them to explain exactly what DNA sequencing is, because I don't ... really get a hang for what this is, or what use it has, or how it can be practically implemented, what it can be used for, what products are expected to come out of it. It didn't really explain that well what it was - just talked about DNA sequencing all the time. I vaguely know what DNA is, but I don't have much of an idea. Manual and semi-automated sequencing was talked about, but at the end I didn't really come out with a feeling for what it was, or what it did or who'll buy it - and that's quite a bad point.'
>
> Venture capitalist 01.

> 'Some [plans] are considerably more detailed in their descriptions of the technology. At a superficial level,

the technology was explained OK. Neither was described in great detail, although that's what I want at this level.'

Venture capitalist 02.

9.4.5 Mistakes in the proposals.

Finally, although both proposals had been reviewed on several occasions before being sent to the participants for evaluation, a number of errors remained. These were mainly spelling errors, mentioned by four participants. More seriously, two participants, venture capitalists 06 and 10, found major errors in the financial information of both BIL and TRI. For the latter, this was sufficient to reject BIL without any further evaluation.

[referring to the financial information presented on page 14 of the proposal];

'I assume that the R&D figure is a cost [BIL] are paying for R&D. 1987 shows a cost of £25,000 reducing the operating surplus of £21,000 to -£4,000. In 1988, they show R&D not as a cost but as an income - I suspect it should have been a cost - reducing the operating surplus to £6,000, not £76,000 as shown. If so, then this isn't a business. This destroys the whole thing. There's only two years of the financial plan and a year's reasonable trading profit of £76,000 on a turnover of [?], but now it looks a total disaster ... I can't leave that ... At that point I'd hand it back to the company and say they've got to re-think the whole thing, and that's as far as I went with the evaluation.'

[Referring to the financial projections information provided on page 15 of TRI]

'They give the number of units they're going to sell in year 4 as 1,000 units. At $600 a unit, that's an income of $600,000. But if you turn to the financials [on page 19] they show an income of $300,000. I don't know if this is a deliberate mistake or not, but if you work out the sales of units quarter by quarter (page 15) then the income stated on page 19 is exactly half of what it should be ...'

Venture capitalist 10.

9.4.6 Summary.

This brief, selective overview of the evaluation of the two proposals has identified a number of issues of general relevance to the remainder of this analysis. It is apparent that the way in

which the two proposals were perceived by the participants demonstrates a marked degree of individuality in the evaluation. This introduces two further aspects of venture capitalist decision making, namely:

(i) why are particular items of information chosen for evaluation? and
(ii) why are particular judgements formed on these items of information, that is, what is the basis for the evaluator's decision?

With this in mind, the remainder of this Chapter describes the way in which a more quantitative analysis of the evaluations was approached, in order to identify what the key determinants of the evaluation decision were.

9.5 Preparation of Transcripts for Analysis.

The first stage of the analysis involved transforming these raw transcripts into a form amenable for further investigation. This section describes how this was done.

9.5.1 Analysing the comments as a series of statements.

It is possible to summarise the comments made in the transcripts as a series of discrete statements on items of information contained in each proposal. Consider, for example, the following comments on TRI made by one venture capitalist:

> 'Just from the criteria [deal screening] point of view we'd have rejected one of these [TRI] because it was US based; automatically, we wouldn't have looked at it any further ... Again, I think we'd have been more likely to have rejected the Tissue Reproductions Inc. one [proposal] because it's too early in the start-up stage for us. It's sort of a company that hasn't really begun manufacturing things, it hasn't really got off the ground, it hasn't already got a sales chart established. Because we only do development capital as opposed to venture capital officially. And as I say, biotech is very high risk, we don't really know what we're talking about when we're looking at this (I shouldn't really say that!). So certainly, initially, we'd have regarded the Tissue Reproductions with a great deal of suspicion.'

The statements derived from these comments were;

1. US based,
2. Too early stage - not yet manufacturing, no sales established,
3. Biotech is very high risk.

9.5.2 Classifying the evaluation statements.

It was recognised that these statements could be classified in a number of ways. For example, an attempt was made to sort them into classes according to the following types of statement;

(i) with respect to deal screening criteria;
(ii) with respect to other plans dealt with, or general statements (eg 'biotech is high risk', 'plan is average');
(iii) statements specific to the plan (eg 'what are the FDA?', 'figures hard to analyse');
(iv) a combination of (ii) and (iii) (eg. 'aware of need for marketing'); and
(v) statements comparing BIL and TRI.

However, this classification proved unwieldy to use in practice. Instead, a simpler method of classifying the statements was decided on, based on two headings; rejection statements, namely statements which indicated that an item of information had negatively influenced the evaluation, and acceptance statements, those aspects of the plan which favourably influenced the evaluation. As the analysis progressed, the following additional sub-classifications were created.

(i) Rejection statements:

(a) Absolute rejection.
The proposal would be rejected out of hand on the basis of this item of information. These were mainly deal screening criteria (such as 'company is US based').

(b) Major rejection.
The item of information represented a serious flaw in the investment proposition. Although not sufficient in itself to lead to immediate rejection, the evaluator saw

the item as a serious impediment to investment. Such statements included those on the strength of the management team, company profitability, etc. A significant number of major rejection statements could cause the proposal to be rejected.

(c) Minor rejection.
These were general statements which in themselves were not significant in reaching the overall decision, but which were, nevertheless, an irritant to the evaluator. These included statements such as 'insufficient financial information' - a common problem encountered in business propositions, but one which the evaluators are used to.

(ii) Acceptance statements:

(a) Minor acceptance.
Items of information which were considered favourably and may have influenced, but were not directly involved in reaching, the overall evaluation decision.

(b) Major acceptance.
Items of information which appeared to be important to the evaluator in reaching a decision to pursue the proposition as an investment candidate.

It will be noted that there is no absolute acceptance class, as no investor would make a firm decision to invest in a proposition solely on the basis of a business proposal. Such a decision would at least have to be confirmed in a meeting with the entrepreneurs involved which is, of course, impossible in this study.

It was found necessary to create a third classification of comments, namely neutral statements. These included items of information with which the evaluator was not familiar, or statements which appeared to have no influence at all on the investment decision.

Figure 9.2 on the next page displays the analysis of an evaluation of the TRI proposal by one of the participants.

Figure 9.2 Classification of evaluation statements made by venture capitalist 01 on the TRI proposal.

01/TRI/1.

REJECTION				ACCEPTANCE	
Absolute	Major	Minor	Neutral	Minor	Major
1. US based.					
2. Too early stage - not yet manufacturing, no sales established.					
3. Biotech very high risk.					
			4. What are the FDA. What does it mean to have FDA approval. 4a. How can plastic surgeons test the product without FDA approval. 4b. FDA approval as a means of creating lead time - explain.		
		5. Figures as presented are quite hard to analyse.			
		6. Not looked at from investors point of view: no funding structure. 6a. Didn't indicate investment realisation/exit route. 6b. Didn't indicate rate of return expected. 6c. (But quite usual for financial information to be inadequate.)			
				7. Showed product/service was viable.	
					8. First of a series of products.
					9. Management are aware of the need to market the product.
					10. Management have put money in themselves.
		11. Management are scientists not businessmen, despite past experience.			
			12. Do mention getting a business manager - but should have assembled management team before approaching investors.		
			13. Foundation grant - what rights/obligations are attached to this.		
			14. Where will plastic surgeons publish their findings. How were the plastic surgeons chosen.		
				15. Mentioned prior business experience - would have to check this independently.	

Figure 9.2 (continued)

01/TRI/2.

REJECTION				ACCEPTANCE	
Absolute	Major	Minor	Neutral	Minor	Major
			16. Programme of acquisition mentioned - how will they carry that out.		
					17. Technical explanation is pretty good.
			18. Don't need to know product information at this stage - more about business and management as a whole, state of progression etc.		
			19. Why should sales depend on doctors marketing ability.		
			20. Competitor products talked about, but would be interesting to know about competitor pricing too.		
			21. Would talk to plastic surgeons to see if the company has any profile.		
			22. Implies that sometimes cells can't be grown - how often is this the case.		
			23. Geographical penetration - how will they grow and how far.		
			24. They've two supply houses. Good that they've got two, but how reliant are they on them.		
			25. Would look thoroughly at background of girl who will be financial controller.		

9.5.3 Categorisation of the evaluation statements.

In the second stage of preparing the data, these statements were grouped together under the following general headings, or categories;

1. Management,
2. Marketing,
3. Product,
4. Financials,
5. Competition,
6. Proprietary Position of Technology,
7. Stage of Company Development,
8. Comments on Proposal,
9. Geographic Location of Enterprise (TRI only) and
10. Product Liability (TRI only).

Table 9.5 below shows the statements put into one of these categories, the example used being that of the statements made by the venture capitalists on aspects of the management team of TRI. The three number code preceding each statement identifies;

(i) the venture capitalist, eg. (01/ /),
(ii) the order in which the statement was made in the evaluation, eg. (/11/), and
(iii) the classification of the statement, eg. (/ / 6), where;

1 = Absolute rejection,
2 = Major rejection,
3 = Minor rejection,

4 = Neutral,

5 = Minor acceptance, and
6 = Major acceptance.

Table 9.5 Statements made on the management and personnel of TRI.

01/10/ 6	Management have put money in themselves.
01/11/ 2	Management are scientists not businessmen, despite past experience.
01/12/ 3	Should have management team in place before approaching investors.

... continued

Table 9.5 (continued)

01/15/ 5	Mention prior business experience - need to check independently.
01/25/ 4	Would look thoroughly at background of girl who will be financial controller.
02/ 6/ 2	Not impressed with management experience.
02/19/ 2	No real commercial experience, no actual line responsibility.
04/ 5/ 4	Any US venture has good management - success depends on product, competition, research.
05/ 7/ 2	Question calibre of people - both highly technical.
05/ 8/ 4	Previous experience of running a company - no effect (on evaluation - considered irrelevant).
07/ 1/ 2	No adequate management team.
08/ 9/ 2	Whole section on management team much too vague - who are other people, are they in place?
08/20/ 2	Not clear who management team are ie. what part do Smith/Jones play.
08/23/ 2	Question competence of management.
09/ 6/ 2	Management team unbalanced - no marketing department, business manager too low in organisation.
10/11/ 2	Very sketchy on employees - doesn't say who they are, or how many
10/12/ 4	Only the management team are mentioned.
10/23/ 2	Wouldn't allow one of the founders to have outside interests.
11/ 4/ 2	Management experience looks very boffinish.
12/ 2/ 5	Management are very good technical experts - if c.v's. are sound, gives some level of comfort.
12/ 3/ 2	No evidence of management starting/growing a company - technical experts not businessmen.
12/ 4/ 3	Not enough on Smith's company - is it a hobby ('box shifting'), just distribution or marketing too.
12/ 5/ 2	Lack of information on c.v's. relating to business experience/track record of growing a company is a black mark.
12/11/ 1	Marketing highlights weakness in team; they have the technical knowledge, some business/marketing experience, but not enough to grow the company.
13/ 3/ 2	Doctors are all scientists, no interest in the commercial side of things except they've set up their own company - a big warning note.
14/ 4/ 4	Need to establish the company have commercial as well as technical skills.
14/ 5/ 3	Would largely discount consultancy experience with Sunkist.

... continued

Table 9.5 (continued)

14/ 6/ 4	Would need to find experience gained in running surgical supply company - to find what management/marketing/financial control skills they have.
14/ 7/ 6	From c.v., technical skills are fine.
14/ 8/ 4	Are much more interested in commercial skills.
14/ 9/ 2	If commercial skills aren't there, wouldn't stop us doing the deal. Would ask them to get commercial skills on board before doing the deal.
14/12/ 4	If everything is OK, we would get them into a meeting and plug away at questions, particularly commercial skills.
14/21/ 6	Compared to BIL, they appear to have commercial ability.
15/ 8/ 6	Management come across as a good mix - have experience of their industry, of making money before.
15/ 9/ 4	Would want a business manager in place before cash goes in.
15/16/ 6	C.v's. read well - would certainly want to meet these people - better than BIL.
16/ 8/ 6	Good they've made their own financial commitment and have money at risk.
16/14/ 5	President has experience with another company.
16/15/ 3	Hiring a business manager - what role? Normally chief executive is business manager.
16/22/ 4	Who in the company has the know-how? Can they just up and leave?
17/ 8/ 2	Two-thirds of management structure is for R&D.
17/10/ 3	Management team is undersold.
18/ 2/ 2	Question calibre of management.
18/ 9/ 2	No proven management track record, the company set up previously isn't impressive, no major business experience in management team, no real line experience - would want a businessman there.
19/ 5/ 6	Lead principals - prior business experience appears successful - good and unusual to have technologist with business skills.
20/ 5/ 6	Other end of scale of naivity cf. BIL - principals haven't taken salaries out, have considered profit sharing schemes etc - gives comfort they can run a business.
20/ 6/ 3	Won't invest where one partner has outside interests.
21/14/ 5	Principal has founded and run a successful company.
21/15/ 3	Financial controller - very important, need more information.

9.6 Analysis of the Evaluation Statements.

Having completed the initial analysis of the venture capitalists comments, two approaches were adopted in analysing the statements obtained. The first used these statements as the basis for a content analysis, the contents being defined by statements made about discrete items of information contained within each proposal. The aim of doing so was to find what items of information contained within each proposal actually elicited comment, and what form (favourable or otherwise) this comment took. It was hoped that this would provide a further insight into the evaluation of each proposal, and individual venture capitalists' approaches to their evaluations.

The second approach was to 'quantify' these statements. In order to do so, it was intended that a scoresheet be prepared which would be based on the items of information the venture capitalists themselves identified as important in reaching their investment decision. This would then be used to codify the evaluations and perform a statistical analysis. The aim was to correlate items of information in the proposal to the eventual evaluation decision, in order to find the key determinants of the decision.

9.7 Content Analysis of the Evaluations.

The content analysis was divided into two parts. In the first instance, the total number of statements assigned to each category (management, marketing and so forth) was found, in order to provide a comparison of the overall evaluation of the two proposals. Second, the frequency with which individual statements were made was calculated, in order to identify what issues appeared to be influencing the investment decision.

9.7.1 Assignment of statements to categories.

It will be recalled (section 9.5.3) that the coded statements were assigned initially to one of ten categories. This assignment is shown in tables A.4.1.1 and A.4.1.2 of appendix 4, section 1. Table 9.6 overleaf summarises the information contained in these two tables.

Table 9.6 Total number of statements made: comparison of BIL and TRI.

Category	Number of Statements made		Percentage	
	BIL	TRI	BIL	TRI
1. Management	52	49	11.8	12.6
2. Marketing	85	63	19.3	16.3
3. Product	80	70	18.2	18.1
4. Financials	109	86	24.8	22.2
5. Competition	30	21	6.6	5.4
6. Ownership of product	18	7	4.3	1.8
7. Stage of company development	25	11	5.7	2.9
8. Comments on proposal	41	26	9.3	6.7
9. Geographic location of enterprise (TRI only)		12		3.1
10. Product liability (TRI only)		43		11.1
	440	388	100.0	100.2

Table 9.6 data suggests that, in overall terms, the degree to which these items of information were focussed on in evaluating the proposals was similar in both instances. The major difference is the product liability aspect of TRI, which attracted some considerable comment.

In both cases, financial information was concentrated on more than other items of information, although both marketing and product information were also commented on extensively. Given that assessment of the management team was specified as the most important part of the evaluation process (since management are seen as the most crucial element in the success of any enterprise; see Chapters 5 and 6), it is perhaps surprising that more comments were not made about management aspects of the proposals. A likely explanation is that management are more usually assessed face-to-face, rather than on the basis of curriculum vitae.

9.7.2 Scores given for categories.

The tables presented in Appendix 4.2 display the frequency with which individual statements about each proposal were made. In addition, this Appendix records the classification of the statements made, where 1 = absolute rejection and 6 = major

acceptance. This enables an average score for any category of information to be calculated as required.

Because relatively few statements were made on the proprietary position of the technology, these are included in the product category in this summary.

Table 9.7 below summarises the information presented in appendix 4.2.

Table 9.7 Comparison of scores given for BIL and TRI.

Classification	Number of Statements		Mean Score		S.D.	
	BIL	TRI	BIL	TRI	BIL	TRI
1. Management	52	49	3.15	3.31	1.32	1.49
2. Marketing	85	63	3.08	2.49	1.08	1.11
3. Product	98	77	3.24	2.96	1.20	1.09
4. Financials	109	86	2.76	2.47	1.00	0.79
5. Competition	30	21	2.57	2.48	0.88	0.50
6. Stage of company development	25	11	3.64	1.64	1.47	0.77
7. Comments on proposal	41	26	3.51	3.62	1.23	1.60
8. Geographic location of enterprise (TRI only)		12		2.17		1.52
9. Product liability (TRI only)		43		2.67		0.88

Having completed the classification of the statements, it was now possible to investigate further the data provided in table 9.3, namely whether the proposals were representative of the type of proposal the participants actually received, that is, whether they were realistic.

In total, 16 participants passed some comment on the BIL proposal, and 14 for TRI. The analysis of statements in table 9.7 shows that 41 statements were made in total about BIL and 26 about TRI. The mean weighted scores for each (on the classification rating scale previously described, where 1 = absolute rejection, 6 = major acceptance) were 3.51 for BIL and 3.62 for TRI. This confirms the earlier finding that, overall, the proposals were seen as average, although it does suggest that BIL was seen as marginally poorer in its presentation.

In most instances, the categories of information appear to be receiving about the same scores. On the whole, TRI was scored slightly lower all round, although markedly different scores were given for marketing (2.49 against 3.08 for BIL) and, especially, stage of company development (1.64 against 3.64 for BIL). Clearly, in the case of TRI the geographic location of the enterprise and product liability issues also counted heavily against a favourable evaluation.

Finally, table 9.8 on the next page shows the items of information which were identified by individual participants as being the cause of an immediate rejection decision. Note that one participant may have identified more than one item of information here. The items selected indicate that a number of determinants for the rejection decision exist beyond simple deal screening criteria, although the consensus expressed over the stage of company development and geographic location of the enterprise in the case of TRI indicates the importance of these criteria in the evaluation of this proposal.

9.7.3 Summary of content analysis.

The content analysis presented here has been useful in highlighting the issues identified by venture capitalists in their evaluation of the two proposals. It will be recalled that the aim of this analysis was to find what the participants themselves deemed important in reaching their evaluation decision. In this respect the analysis has been successful although, as the full analysis presented in Appendix 4 shows, it does highlight the fact that, potentially, the determinants of the evaluation decision are extremely diverse. That such a variety of items were identified were made provides a further indication of the extent to which the evaluation decision is an individual one. However, an obvious limitation of this approach is that, for example, whilst one venture capitalist may have expressed their opinion of management in a single statement, another may have made several statements in arriving at the same conclusion. Therefore, although the content analysis highlights certain key points in the two plans, it is less successful in demonstrating the relative importance of

Table 9.8 Reasons for given for rejecting proposals.

	BIL	No.	TRI	No.
Management	Completeness of management team	1	Marketing expertise	1
Marketing	Summary of opportunity	1	Acceptance into markets	1
			Credibility of strategy	1
			Advertising and promotion	1
			Decision making	1
			Description of effort	1
Product	Relationship to follow-on products	1		
	Ownership of technology	1		
	Uniqueness of product	1		
Financials	Adequacy of information	1	Margins	1
			Gross profit	1
	Current status of firm	1		
	Expectations of reward	1		
	Amount of profit forecast	1		
Competition	Technical edge	1		
Stage of company development	Start-up super-imposed	1	Too early/ a start-up	6
	Isn't an operation of scale	1		
Comments on proposal	Information provided	1		
Geographic location of enterprise (TRI only)			US based	7
Product liability (TRI only)			The FDA process	1

these points. This is in spite of the scores given to individual statements. The next section, which seeks to develop a statistical approach to analysing the evaluation decisions, takes this into

account by summarising in a single score the statements made on related items of information.

9.8 Statistical Analysis of the Evaluations.

The intention behind performing a statistical analysis was to explore the possibility that the evaluation of items of information contained within each proposal could be correlated with the eventual evaluation decision. However, rather than submitting a scoresheet or checklist for the venture capitalists to fill in (which was done in any case, as shown in Chapter 10), it was intended that the categories of information considered relevant to the evaluation should be constructed from the venture capitalists own comments. This would in turn be used to codify the participants statements on which statistical testing for significant relationships could be carried out.

The statements were converted into a form amenable for statistical analysis by coding them on to a scoresheet derived from the content analysis (appendix 4.2), cross referenced with two other scoresheets. These were the Cope Pence scoresheet, used for generating the quantitative data analysed in chapter 8, and a questionnaire devised by Tyebjee and Bruno (1984). These are presented in Appendix 2.2 and 2.4 respectively.

The result was a 24 category scoresheet, shown in annotated form in table 9.9 overleaf. This table shows;

(i) the headings under which the venture capitalists comments were scored,
(ii) an explanation (if appropriate) of the types of comments the category embraces,
(iii) the components of the category (broad descriptors of the specific comments scored in each category, summarised from the content analysis),
(iv) a cross reference to the Cope Pence and Tyebjee and Bruno scoresheets and
(v) an indication of whether the particular comment was specific for TRI or BIL.

Table 9.9 Scoresheet used for encoding venture capitalists statements on the BIL and TRI business proposals.

Key: CP = reference to a category of the Cope Pence scoresheet.

T&B = reference to a category of the Tyebjee and Bruno scoresheet.

BIL = category, or component of category, refers specifically to the Brookfield Instruments proposal.

TRI = category, or component of category, refers specifically to the Tissue Reproductions proposal.

Category A. Management skills. (T&B 1, CP 21.)

Exposition: general appropriateness of the entrepreneurs skills and expertise to business management.

Components: A.1 Management are scientists not businessmen

A.2 Management team business/commercial expertise (T&B 3, CP18).
A.3 Management technical expertise. (T&B 4, CP 19.)
A.4 Management marketing expertise. (T&B 2.)
A.5 Management team structure.
A.6 Adequacy of information on management backgrounds. Management c.vs. (T&B 5.)
A.7 Employees.

Category B. Management commitment. (CP 20.)

Components: B.1 Financial commitment.
B.2 Degree of personal commitment.

Category C. Marketing strategy.(CP 6.)

Exposition: The way in which the business plan approaches issues of marketing the product.

Components: C.1 Overall marketing strategy (T&B 11, T&B12).
C.2 Advertising strategy.
C.3 Selling/sales activities.
C.4 Customer purchasing arrangements.

Category D. Market share.

Components: D.1 Market share. (CP 15.)
D.2 Market penetration. (CP 2.)

Category E. Market size.

Components: E.1 Market size. (T&B 13, CP 10.)
E.2 Market growth. (T&B 14.)

... continued

Table 9.9 (continued)

Category F. Product. (CP 5.)

Exposition: 'Conceptualisation' of the product.

Components: F.1 Credibility, viability, 'attractiveness'. (CP 1.)
F.2 Technical explanation of product.
F.3 Understanding of product.

Category G. Research and development (R&D) activities. (CP 9.)

Exposition: Degree of resource commitment required to develop present and future products, including financial commitment.

Components: G.1 Stage of development of product.
G.2 Commitment (including financial commitment) to R&D.
G.3 Development of follow-on products.

Category H. Production/manufacture. (T&B 10.)

Components: H.1 Failure rate in manufacture.
H.2 Feasibility of scaling-up product for production.
H.3 Ability of company to achieve manufacture of product. (T&B 10.)

Category I. Financial information.

Components: I.1 Presentation of financial data.
I.2 Adequacy of financial data.
I.3 Historical financial data.

Category J. Analysis of financial data.

Components: J.1 Funding structure of company.
J.2 Appropriateness of funding required. (CP 14.)
J.3 Timing of funding.
J.4 Cost assumptions of business.
J.5 Price elasticity.
J.6 Adequacy of margins. (CP 12, T&B 6.)

Category K. Investor expectations.

Components: K.1 Adequacy of return, potential to achieve adequate return. (CP 13.)
K.2 Timescale to profit. (CP 13.)
K.3 Timescale to investment realisation. (CP 16, T&B 19.)
K.4 Exit potential. (T&B 20, CP 16.)

... continued

Table 9.9 (continued)

Category L. Product liability. (CP 7, T&B 15.)

(TRI only.)

Exposition: Degree to which potential hazards associated with product influence evaluation.

Components: L.1 Attitude (of proposal) to product liability issues.
L.2 Side effects/potential hazards of technique.
L.3 Vulnerability to law suits.
L.4 Ability to gain insurance cover.

Category M. FDA approval. (T&B 15, CP 8.)

(TRI only.)

Exposition: FDA (Food and Drug Administration) approval is a statutory, regulatory requirement which must be gained for clinical products to be used in the US.

Components: M.1 Meaning of FDA approval.
M.2 Time required to gain FDA approval, stage in FDA approval process.
M.3 Proposal's attitude to FDA approval.
M.4 FDA approval needed before funding.

Category N. FDA approval and marketing.

(TRI only.)

Exposition: The use of FDA approval procedure to create lead time over potential competitors.

Category O. Competition. (CP 17.)

Components: O.1 Availability of substitute products. (CP 3.)
O.2 Information on competitors.

Category P. Barriers to entry to market from competition.

Components: P.1 Protection from competitive entry. (T&B 16.)
P.2 Barrier to entry to competition presented by product characteristics. Technical edge. (T&B 7.)

... continued

Table 9.9 (continued)

Category Q. Proprietary position of technology. (T&B 8, CP 17.)

Exposition: The degree to which the company can protect its technology.

Components: Q.1 Patentability.
Q.2 Ownership of technology.
Q.3 Obligations to funding organisation supporting original research.

Category R. Clinical use of product.

(TRI only.)

Components: R.1 Choice of plastic surgeons.
R.2 Publication of research findings.
R.3 Profile of company/technique amongst users. Use of users to recommend product (peer recommendation).

Category S. Source of supplies (T&B 9).

Exposition: Questions relating to supply of equipment, reagents etc. required for manufacturing product.

Components: S.1 Reliance/dependence on sources of supply.
S.2 Potential for obtaining supplies from elsewhere if necessary.
S.3 Reliability/quality of supplies and supply sources.

Category T. Comments on plan.

Exposition: Presentation of plan, approach to relevant issues.

Category U. Acquisition programme.

(TRI only.)

Exposition: Questions relating to company's plans for growth through acquisition of related companies.

Category V. Project unsuited to small company.

Exposition: Suitability of this type of company to take on this development.

Category W. Stage of company development.

Category X. Geographic location of enterprise.

(TRI only.)

... continued

Table 9.9 (continued)

Category Y. Overall evaluation decision.

Exposition: The score of 1 to 5 obtained from the evaluation rating scale (see Appendix 2.3) where 1 = immediate rejection, 5 = strong desire to invest in proposition.

Category Z. Opinion of the proposal as a document.

Exposition: A score derived from the scoresheet (appendix 2.3) which described the venture capitalists opinion of the proposal as a document, on a scale from 1 = poor and 5 = good.

NB. Unassigned categories from the Cope Pence and Tyebjee and Bruno scoresheets are;

CP 11 - Distribution system

T&B 16 - Resistance to economic cycles,
T&B 18 - Hedge against current investments,
T&B 21 - Tax benefits of venture
T&B 22 - Protection against downside risk.

The statements made by the 21 venture capitalists were summarised to give a representative assessment of their opinion on each category of information. This was done for TRI in the first instance, as is shown in figure 9.3 overleaf. The intention was that a statistical analysis be performed which, hopefully, would demontrate that some relationship(s) existed between the overall evaluation of the proposal and the favourable or other wise evaluation of items of information contained within the proposal.

Figure 9.3 Assignment of statement summaries to categories for statistical analysis.

Key: The numbers in the matrix refer to the 1 to 6 (absolute rejection to major acceptance) scoring system described in section 9.5.3.

	Venture capitalist																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Cat.																					
A	2	2		4	2		2	2	2	2	2	2	2	4	6	4	2	2	6	6	4
B	6									2						6				3	
C	4	2	1			2		2	2	2	4	1	2	3		2	2		3	5	2
D			2				2	2		3	2					2					
E								2		2				6	3	2	3	2			
F	4	2	5	4	2	2			3	2	3	6		3				4	6	5	3
G	5				2		2	2	2		2	2	2		2	3	2				
H	3	2	2		2	2	2	2	2		3		2				3				3
I	2	3		2				2						4	3	3			3		2
J	2	2	1		2			2	2	2	2		2	4	3	3	2	2	4		2
K	2	3			2		2	2			2		2	4	3			2		3	3
L		2	3	2	2		2		2	2		3	2	2			2	2		5	2
M	3	2	3				2	2		2	3			3		3	2	3			
N	4	2										3		3	3	2				5	
O	3	2	2									3	3			2	2				
P		2	3							2			3			3	2	2			3
Q	3									2	3				3	3	2			4	
R	3	2	3						3	3				3	3	3					3
S	3									2	3				3	3					
T		4	4		2			2	2	2				6	3	5			5	5	
U	3							3								2					
V		1	2					2			2							2			
W	1		1	1				1		1									1		
X	1			1	1	1		1													
Y	1	1	1	1	1	2	1	1	2	1	2	1	2	2	4	2	1	1	1	4	2
Z	3	3	2	4	2	3	2	2	2	1	2	3	2	4	3	3	2	2	3	5	3
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Venture capitalist																				

At this stage a problem with this approach can be seen as, when an analysis such as this is performed, the criteria used by individual participants to evaluate proposals does not conform to a set of convenient pre-set categories. In reality, the highly individual evaluations meant that there were a large number of categories where no value could be assigned - too many for a statistical analysis to be performed on this data.

In order to perform any valid statistical procedure it was necessary, therefore, to modify the way in which the data was

coded. One way of doing this would have been to treat the missing scores in the same way as if the category represented an item of information which had received a neutral evaluation. However, the fact that items were identified indicates they were considered, which is different from saying they were ignored completely. Consequently, the decision was taken to convert the data into a form of ranked score for each category.

The way in which this was done depended on two assumptions. First, if a venture capitalist had not made a statement on an item of information, it was assumed that this item was not relevant to formulating the decision to proceed with the evaluation.

The second assumption arises from the development of the original classification of statements into accept or reject classes. If a category contained a score of 1, 2 or 6 (corresponding to absolute or major rejection and major acceptance), it was assumed that these categories were important in reaching the evaluation decision. If the categories were scored 3,4 or 5 (corresponding to minor rejection, neutral, or minor acceptance) it was assumed that, whilst these items were not <u>important</u> in reaching the evaluation decision, they were nevertheless worth identifying. Therefore, they may have had <u>some</u> influence on the decision (in contrast to items of information <u>not</u> identified).

On this basis, the score presented in figure 9.3 were converted to the following scale:

1 = category not identified;

2 = category identified, but not important in reaching the investment decision;

3 = category identified as important in reaching the investment decision.

Note that with this assignment, shown in figure 9.4 (on the next page), it is not possible to show if categories identified as important in reaching the evaluation decision favourably or negatively influenced the evaluation. It is possible to show that they had an influence and this influence can be ranked in terms of

importance, but it is not possible to state what form this influence took.

Figure 9.4 Influence of categories on evaluation of proposals - presentation for statistical analysis.

Key: 1 = category not identified.
2 = category may influence, but is not important in reaching, evaluation decision.
3 = category important to evaluation decision.

	Venture capitalist																			
Cat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
A	3	3	1	2	3	1	3	3	3	3	3	3	3	2	3	2	3	3	3	3	2
B	3	1	1	1	1	1	1	1	1	3	1	1	1	1	1	3	1	1	1	2	1
C	2	3	3	1	1	3	1	3	3	3	2	3	3	2	1	3	3	1	2	2	3
D	1	1	3	1	1	1	3	3	1	2	3	1	1	1	1	3	1	1	1	1	1
E	1	1	1	1	1	1	1	3	1	3	1	1	1	3	2	3	2	3	1	1	1
F	2	3	2	2	3	3	1	1	2	3	2	3	1	2	1	1	1	2	3	2	2
G	2	1	1	1	3	1	3	3	3	1	3	3	3	1	3	2	3	1	1	1	1
H	2	3	3	1	3	3	3	3	3	1	2	1	3	1	1	1	2	1	1	1	2
I	3	2	1	3	1	1	1	3	1	1	1	1	1	2	2	2	1	1	2	1	3
J	3	3	3	1	3	1	1	3	3	3	3	1	3	2	2	2	3	3	2	1	3
K	3	2	1	1	3	1	3	3	1	1	3	1	3	2	2	1	1	3	1	2	2
L	1	3	2	3	3	1	3	1	3	3	1	2	3	3	1	1	3	3	1	2	3
M	2	3	2	1	1	1	3	3	1	3	2	1	1	2	1	2	3	2	1	1	1
N	2	3	1	1	1	1	1	1	1	1	1	2	1	2	2	3	1	1	1	2	1
O	2	3	3	1	1	1	1	1	1	1	1	2	2	1	1	3	3	1	1	1	1
P	1	3	2	1	1	1	1	1	1	3	1	1	2	1	1	2	3	3	1	1	2
Q	2	1	1	1	1	1	1	1	1	3	2	1	1	1	2	2	3	1	1	2	1
R	2	3	2	1	1	1	1	1	2	2	1	1	1	2	2	2	1	1	1	1	2
S	2	1	1	1	1	1	1	1	1	3	2	1	1	1	2	2	1	1	1	1	1
T	1	2	2	1	3	1	1	3	3	3	1	1	1	3	2	2	1	1	2	2	2
U	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	3	1	1	1	1	1
V	1	3	3	1	1	1	1	3	1	1	3	1	1	1	1	1	1	3	1	1	1
W	3	1	3	3	1	3	1	3	1	3	1	1	1	1	1	1	1	1	3	1	1
X	3	1	1	3	3	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1
Y	1	1	1	1	1	2	1	1	2	1	2	1	2	2	4	2	1	1	1	4	2
Z	3	3	2	4	2	3	2	2	2	1	2	3	2	4	3	3	2	2	3	5	3
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Venture capitalist																				

On the basis of this data, Spearman rank correlation coefficients were calculated. These are summarised in figure 9.5 overleaf.

Figure 9.5 Results of statistical analysis of venture capitalists' responses on TRI business proposal.

Key: + = positive relationship between two variables.
- = negative relationship between two variables.

Cat.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	X						+			+	+												-		-	
B		X						-						+			+		+		+					
C			X								-				+	+										+
D				X									+								+	+				
E					X			-					+													
F						X	-						-													
G							X																	-		
H								X		+						-										
I									X												+			+		
J										X					+							+				
K											X															+
L												X			+			-		-		-				
M													X		+	+										
N														X	+			+								
O															X	+										
P																X								-		
Q																	X		+							
R																		X	+	+						
S																			X		+					
T																				X						
U																					X			+		
V																						X			-	
W																							X	+		
X																								X	-	
Y																									X	
Z																										X

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

9.8.1 Interpretation.

At first sight, the Spearman correlations appear to reveal some interesting relationships. In particular, a significant relationship was demonstrated between the evaluation of 'Management skills' (Category A), 'Project unsuited to small company' (Category V) and 'Geographic location of enterprise' (Category X) and the overall evaluation of the proposal (Category Y).

However, interpreting the meaning of these relationships is, in fact, both highly problematic and questionable. In looking at other relationships, reasonable explanations can be attributed to

the correlation of some categories with others. For example, a relationship was found between the 'Management skills' and 'Analysis of financial data' categories. This would seem reasonable, on the basis that the importance attached to the quality of the management team may reflect expectations of reward. In contrast, in other instances there appears to be no explanation as to why two categories are linked. No explanation is apparent, for example, for why the 'Management skills' and 'R&D commitment' categories should be related. Table 9.10 below displays these and some examples of other relationships shown in figure 9.5 under two headings; 'meaningful' and 'meaningless'.

Table 9.10 Examples of some explainable ('meaningful') and unexplainable ('meaningless') relationships between categories as defined by significant Spearman correlation coefficients.

'Meaningful'		'Meaningless'	
A. Management skills J. Analysis of financial data	0.521 p = 0.008	A. Management skills G. R&D commitment	0.601 p = 0.002
A. Management skills K. Investor expectations	0.515 p = 0.008	A. Management skills W. Geographic location	-0.411 p = 0.032
A. Management Skills Y. Evaluation scale	-0.521 p = 0.008	B. Management commitment H. Production/manufacture	-0.370 p = 0.050
C. Marketing strategy K. Investor expectations	-0.439 p = 0.032	B. Management commitment N. FDA and lead times	0.425 p = 0.027
C. Marketing strategy O. Competition	0.511 p = 0.009	B. Management commitment Q. Proprietary position of technology	0.664 p = 0.001

Because of the difficulties in assigning meaning to some of these relationships, it was decided that it would be unsafe to attempt to draw any conclusions from this analysis. The attempt at quantifying the interview data was, therefore, unsuccessful since no relationships could be demonstrated, which could be rigorously defended, between the evaluation of the proposal and the evaluation of items of information within the proposals. For this

reason, an intended investigation using the same methodology to test the evaluation of the BIL proposal was not attempted.

9.9 Insights Gained in this Analysis.

This section contains some observations made during the analysis of the venture capitalists comments on the BIL and TRI proposals, with reference to difficulties encountered in handling the research data and how these difficulties were, or it is suggested could have been, overcome. It is hoped that these observations may be of use to researchers contemplating similar research methodologies. It also includes comments on the evaluation process which were generated in the course of the analysis. Although requiring further investigation before any firm conclusions can be drawn as to their validity, it is believed these comments give some insight into venture capitalist investment behaviour.

9.9.1 Investigator bias.

One of the biggest problems encountered in this analysis was that of trying to reduce the effects of investigator bias. Given the amount of data being handled, such effects were inevitable. For example, a number of different statements could have been generated from the comments made by the venture capitalists; the summary statements used in this analysis are a personal interpretation of these comments. In a similar way, the assignment of these statements to the above mentioned classifications required, in the main, a substantial element of judgement on the part of the researcher. Some unambiguous comments were made; the example given in section 9.5.1, where the TRI proposal did not meet the venture capitalist's deal screening criteria because it was US based, is an illustration of such a comment. The statement generated from this comment and its assignment into the '1' - immediate rejection - classifisation is straightforward. This example illustrates, however, an exception rather than the rule.

In practice, the classification of statements was at times problematic and highly subjective. Whilst in general terms assigning statements to either rejection or acceptance classes presented few problems, further allocation into major or minor

subdivisions of these categories was more difficult. This is not to say that these sub-classifications are invalid; however, criticism can clearly be made that assigning statements within this classification is, in effect, second guessing the participants true intent in making the comment. Furthermore, the negative comments made by someone who was favourably impressed by the proposal overall did not appear (in a subjective sense) to be as negative as those statements made by participants who reviewed a proposal unfavourably. That is, the degree of positive or negative assigned to a statement had to be seen in the context of the overall evaluation decision.

In addition, there were certain instances where an item of information was evaluated negatively, the provision of financial information being a case in point. However, it had already been indicated that this was the norm, that it was expected that proposals in general do not contain the type of information required. Therefore, there was major annoyance that the financial data wasn't there, but minor annoyance because it wasn't expected to be, because in practice it seldom is there. (It might also be mentioned that assigning statements to categories presented even greater problems. This is discussed further in section 9.9.2 below.)

Given the nature of this method of investigation, the problem of assigning statements to classes was to some extent inevitable. Attempts were made to reduce these effects by periodically re-classifying a number of venture capitalists' statements. The classification of statements eventually obtained reflects, it is believed, the participants actual interpretations of items of information within each proposal.

Two ways round this problem are suggested. First, it would have been useful to have returned to a number of the participants within a reasonably short space of time after they had read the proposal to ask if the classification of statements reflected accurately their evaluation of the proposals. This could have been carried out as part of the pilot study, when the proposals were reviewed and found to be acceptable as investment propositions.

Because of time constraints - both on the researcher and the participants - it was not possible to do this in this study.

Second, it would have been useful to have had another researcher - preferably more than one - involved in generating the statements and assigning them to the categories shown. This introduces a more general point, that this type of analysis is perhaps more suited to group rather than individual research.

9.9.2 Why do venture capitalists chose items of information?

As has been noted in earlier sections (see 9.4.6), something which became notable in the course of this analysis was the extent to which individual preferences affected the evaluation of the two proposals. This could account for why certain items of information were chosen and why decisions were reached. Because this present analysis looked purely at the comments generated in the course of the evaluation, it was unable to provide anything other than an incomplete answer to these questions. It is apparent that, in a number of cases, all (or most of the) aspects of the decision were determined by the venture capital fund's deal screening criteria, and it was for this reason that the particular statement was made (for example, 'company is US based', or 'company is too early stage'). However, why an individual evaluator would chose to focus on one aspect of the proposal while ignoring some other aspect is unclear. For example, venture capitalist 3 did not even mention aspects of the management of TRI but focussed instead on market, product and competitive issues.

It will also be noted that, as the content analysis shows, identification of (for example) 'marketing' issues in an evaluation of the proposals is, in effect, an artefact of the classification used in this analysis. This is because 'marketing' - and any other classification - is no more than a general heading under which a range of responses, reflecting the large number of personal interests, perspectives and biases of the evaluators, were encoded. In practice, the individual evaluations were more idiosyncratic than the content analysis might suggest. This in turn would suggest that results obtained using a questionnaire-based approach to study investment behaviour are unlikely to

reflect the actual evaluation processes used by individual evaluators. The use of questionnaires in this type of study is discussed more fully in the introduction of Chapter 10.

Even more confusing was the fact that, where two identical items of information were chosen, two completely different interpretations of this information could be arrived at. This is not to say that there were not major areas of consensus in the evaluations. In the case of TRI, product liability issues were identified as major problems for investment in all but one instance (where product liability was identified as an issue). However, a summary of table 9.5 shows that venture capitalists 1, 2, 5, 7, 8, 11, 12, 13, 17 and 18 do not believe that TRI has an adequate management team, whereas 14, 15, 19 and 20 believe the company does have good management. All have looked at the same information and yet have come to these different interpretations of this information. This example is by no means an isolated case. However, it is not possible to say with any degree of certainty why they have reached these different decisions.

One possible explanation for this divergence of opinion may be that some participants were more willing than others to accept at face value what the plan actually said. In the case of BIL, for example, there was a clear difference between those who believed the management team were capable of manufacturing the automated DNA sequencer, and those who were not. Those who did think the management capable appeared to believe their prior experience, as outlined in the proposal and their c.vs., equipped them for the manufacture of these instruments. Those who were negatively judgemental on this issue appeared to disbelieve this evidence. Perhaps some evaluators lack sufficient experience to judge these issues, are more willing to believe what the entrepreneur tells them, or are simply less cynical, than others.

9.10 Summary.

This Chapter has sought to develop an analytical procedure which would allow the evaluation of the BIL and TRI business proposals to be examined according to criteria which the participants in this study themselves identified. That it was only partly

successful in explicitly determining a set of decision criteria - namely those based on deal screening criteria - points to the individual nature of the evaluations obtained. It is concluded that these findings cast some suspicion on results obtained in other studies which used pre-determined scoresheets or similar devices to obtain information on venture capitalist project evaluation criteria. This conclusion was reached for at least three reasons. First, participants in such studies may be prompted to indentify items in the evaluation procedure they would otherwise not consider. Second, scoresheets reflect what the investigator believes the participant may find important which, it would appear from the findings presented here, is frequently not so. Finally, scoresheets cannot accurately reflect the complexity and subtlety of individual project assessments.

The question of the effect of the individual on the evaluation of BIL and TRI is considered further in Chapter eleven. First, however, the next Chapter presents an analysis of the scoresheet evaluations of the two proposals.

CHAPTER TEN

THE ASSESSMENT AND EVALUATION OF BROOKFIELD INSTRUMENTS LTD. AND TISSUE REPRODUCTIONS INC.: ANALYSIS OF SCORESHEETS

10.1 Introduction.

This chapter presents an analysis of the Cope Pence scoresheet (Appendix 2.2) which was completed by venture capitalists as part of their evaluation of the Brookfield Instruments Ltd. (BIL) and Tissue Reproductions Inc. (TRI) business proposals. Before proceeding with the description of this analysis, a few preliminary comments are necessary.

It will be recalled that the purpose of using this scoresheet was three-fold. First, it was intended to use data obtained from it to compare US and UK attitudes to the TRI proposal. Second, it was not proposed that the scoresheets be used to produce the major findings of this research. Instead, it was included to provide a second method of measuring the venture capitalists responses to the two proposals, in essence providing a back-up (a 'quantitative evaluation') for the qualitative analysis of the unstructured interviews presented in Chapter nine. Third, it was intended to use them to provide some measure of the extent to which interviewer bias was affecting the qualitative analysis of the venture capitalists comments. This was to be done by comparing the scores given by the venture capitalists and those recorded by the interviewer on the basis of their comments. Had, for example, the scores recorded by the participants and the interviewer been markedly different, it would seem reasonable to assume that the interpretation of the participants comments was suspect. The aim was to provide a check for bias in evaluating the venture capitalists' comments on the two proposals. (In Cope Pence's original study, the scoresheets were used solely as the first line of analysis of the interviewees comments, that is, they were designed to provide a method of coding the interviewees' evaluations of her business proposals. It should be noted, however, that Cope Pence used a semi-structured interview protocol

which aided the completion of these scoresheets by the interviewer.)

In practice, it was not possible for the interviewer to complete these scoresheets. There were two main reasons for this. First, there were (almost without exception) too few comments made by any individual venture capitalist which corresponded with, and made it possible to give a score to, even a reasonable proportion of the 21 items on the scoresheet. Second, the comments which were made often did not correspond to any category listed on either the Cope Pence scoresheet or the Tyebjee and Bruno scoresheet (Appendix 2.4).

It will also be recalled that the aim of using an 'open-ended' interview format was to find what items of information the venture capitalists themselves identified as important in reaching their evaluation decision. That the 21 item scoresheet could not be completed infers that the participants were able to arrive at their decision without taking all the factors listed there into account. They either chose to concentrate on a few of the 21 categories or, more frequently, chose items of information not adequately described by the scoresheet. The actions of the venture capitalists who completed the scoresheets substantiate this inference. They frequently found it necessary to re-evaluate the proposals in order to produce scores for the categories.

In summary, attempting to encode the Cope Pence scoresheet showed that the 21 categories bore only partial resemblence to the actual evaluation of the business proposals.

This problem appears to highlight a fairly fundamental methodological issue concerning the use of questionnaires in this type of study. This is; would it have been possible to produce a scoresheet or questionnaire device which would have accurately reflected the venture capitalists actual evaluations of the two proposals?

The construction of a scoresheet or some other form of device for examining the evaluation of the BIL and TRI proposals was not, in any case, attempted. There were two main reasons for this. First,

as stated above, the intention behind using the Cope Pence scoresheet in this study was to obtain data to compare US and UK evaluations of TRI. Hence, the scoresheet was required in its original form. Second, no attempt was made to produce a questionnaire specifically designed for this study because of the size of the pool of venture capitalists available to participate in this study. The interview sample represents approximately one half of the UK venture capital community who would actually be interested in investing in this type of investment proposition. Extensive pilot testing of any questionnaire was, therefore, not possible. The attitude taken - a not unreasonable one, given these constraints - was that the Cope Pence scoresheet had been used in a previous study, was itself based on two previous models of investment decision making and, therefore, would be suitable for use in this study.

However, even if the construction of such a questionnaire had been attempted, the findings of this study appear to indicate that it would not have have been possible to create a device which could have accurately reflected the evaluation of the two proposals.

Finally, some mention must be made of the analytical procedures employed by Cope Pence. In view of the fact that her scoresheets were used in this study in order to compare the UK and US evaluations of TRI, the reasons why her methods of analysis were not pursued require some explanation.

It would be inappropriate to discuss at length and in great detail the actual procedures used in Cope Pence's analysis. This is because certain examples occur throughout her analysis which throw some doubt on the validity of the analytical procedures used. In general terms these relate to the appropriateness of the statistical tests used, bearing in mind the small number of participants involved and the data available. It should be noted that Cope Pence does acknowledge that the reliability of the statistical tests she used is suspect (Cope Pence, 1982:37). That said, her overall - correct - conclusion, that there is some relationship between the evaluation of the fundamental financial characteristics of business proposals and the overall decision to commit further resources to investigating them as investment

propositions, and that this decision is not simply based on whim or 'gut reaction', is not enhanced by her choice of statistical analyses. Given these criticisms, and bearing in mind that even fewer scoresheets were available in this present study, an alternative, more defendable approach to the analysis was necessary.

10.2 Analysis of the Cope Pence Scoresheets.

In all, 16 of the scoresheets presented in Appendix 2.2 were obtained for BIL and 14 for TRI. This corresponds to 80% and 70% respectively of the interview evaluations available.

The reason why some participants refused to fill in the score-sheets is that, having spent an hour or more describing their evaluation of the two proposals, time constraints meant they were unwilling or unable to repeat the exercise with a questionnaire. Of those who did, it appeared that (as has been described in the introductory comments to this chapter) completion of the score-sheet required at least a partial re-evaluation of the proposal.

In any event, because of the small number of score sheets available the range of statistical analysis available for their interpretation was limited.

10.2.1 Chi-square tests for association based on risk, return and liquidity variables.

As a first step, the questions were grouped together into the risk, return and liquidity variables designated by Cope Pence (see section 7 of Chapter 7) and a chi-square test applied, to see what associations, if any, existed between these variables and the overall evaluation score. These associations are in table 10.1 on the next page.

Table 10.1 Chi-square values for association between risk, return and liquidity variables and evaluation scores for BIL and TRI.*

	Proposal	
Variable	BIL	TRI
Risk	7.42 P› 0.10	8.21 P› 0.05
Return	5.31 P› 0.30	6.95 P› 0.20
Liquidity	9.66 P‹ 0.05	9.86 P‹ 0.05

*Full chi-square calculations from which the information shown in this table was derived are shown in tables A.5.1 and A.5.2, Appendix 5.

The data in table 10.1 suggest that an association exists at the 5% level for both BIL and TRI between the evaluation scores and the liquidity variable. In contrast, there appears to be no association in this study between the evaluation score and either the risk or return variables. However, this result is suspect, as the validity of the chi-square test as used here can be called into question. Even when the minus scores were collapsed into a single negative score and the plus scores collapsed into a single positive score, expected cell frequencies of less than 5 were produced in the resulting contingency tables. (The assumptions underlying the chi-square test are expanded upon in section A.5.3 of Appendix 5. Tables A.5.1 and A.5.2 in the same Appendix display the contingency tables from which the values presented above were obtained). This was especially true for the liquidity variable, making the association suggested above unreliable. For this reason, analysis of the data based on Cope Pence's classification of the 21 categories into risk, return and liquidity variables was not pursued further, other than to provide a comparison of the evaluation of TRI by UK and US venture capitalists (see section 10.4).

10.2.2 Chi-square tests for association based on product, market, financial and management variables.

In order to obtain some information from the scoresheets, the categories were re-assigned to four new variables. Evidence produced earlier in this thesis suggests that the key factors governing the evaluation of business proposals are information on the product, market, financial and management aspects of the deal. The 21 categories were, therefore, re-assigned to these four variables as shown in table 10.2 on the next page.

It was recognised that other ways existed of both defining variables and assigning categories to them. Had more scoresheets been available it may have been possible to have used some procedure, such as factor analysis, to identify 'natural' groupings of categories. Given the restriction of the small number of scoresheets available, this option was not possible. The grouping above does, however, represent a 'consensus', to the extent that the assignment of categories to variables was arrived at independently by three individuals. It is, therefore, believed that results obtained from an analysis of the relationship between these variables and the evaluation score given for the BIL and TRI proposals will be of some value in explaining how the evaluation decision was arrived at.

By themselves, the contingency tables produced on the basis of each of these new groupings contained too few observations to do valid chi-square tests. (Section 4 of Appendix 5 contains contingency tables and chi-square calculations for this section.)

Table 10.2 Assignment of categories to product, market, financial and management variables.

Category	Variable			
	Product	Market	Financial	Management
Value to the world	*			
Demand growth		*		
Availability of substitutes	*			
Price elasticity			*	
Technological characteristics	*			
Marketing and advertising strategies		*		
Product liability	*			
Government regulations	*			
R&D commitments			*	
Market size		*		
Distribution system		*		
Margins			*	
Years to maturity			*	
Capital needed			*	
Percentage of market		*		
Exit potentials			*	
Market barriers		*		
Profit and loss experience				*
Technical knowledge				*
Management commitment				*
Management team experience				*
No. of categories per variable	5	6	6	4

However, when two variables were combined, chi-square tests for association between evaluation scores and the scores given for these combined variables could be investigated.

Table 10.3 (overleaf) presents the chi-square values for two variables together for BIL and TRI.

Table 10.3 Chi-square values, two variables combined.

	Proposal	
	BIL	TRI
	chi^2	chi^2
Product and Market	12.72 P< 0.02	9.80 P< 0.05
Product and Financials	9.17 P> 0.05	6.62 P> 0.10
Product and Management	4.72 P> 0.30	4.28 P> 0.30
Market and Financials	21.07 P< 0.001	15.97 P< 0.01
Market and Management	14.07 P< 0.01	9.98 P< 0.05
Financials and Management	10.10 P< 0.05	7.51 P> 0.10

Table 10.4 below provides a summary of the information presented in table 10.3.

Table 10.4 Chi-square values for paired variables.

(i) Brookfield Instruments Ltd.

	Product	Market	Financial	Management
Product	*	12.72	9.17	4.72
Market	12.72	*	21.07	14.07
Financial	9.17	21.07	*	10.10
Management	4.72	14.07	10.10	*

... continued

Table 10.4 (continued)

(ii) Tissue Reproductions Inc.

	Product	Market	Financial	Management
Product	*	9.80	6.62	4.28
Market	9.80	*	15.97	9.98
Financial	6.62	15.97	*	7.51
Management	4.28	9.98	7.51	*

10.2.3 Interpretation of the results of the chi-square test.

The results presented in tables 10.3 and 10.4 suggest that the market and financial variables are the most highly associated with the evaluation score for each proposal. The management and product variables appear to influence the evaluation little, if at all.

For the screening of business proposals, this result would appear to be reasonable. Information presented in Chapter 5, which discusses general issues relating to the assessment and evaluation of business proposals, indicates that venture capitalists are more likely to assess management capabilities on the basis of a face-to-face meeting, rather than information contained in a c.v. Similarly, it was indicated that, as financiers, venture capitalists could not expect to be technologically literate. Hence product information would likewise not greatly influence the early stage evaluation. It seems reasonable to surmise that this result is, therefore, a fair representation of the factors regarded as important in deal screening and the early stage evaluation of business proposals.

In summary, market and financial information appear to be the key items of information contained within these business proposals which determine whether or not they are investigated more fully.

However, the chi-square test only suggests that associations exist - it does not suggest the nature of relationships. In order to carry the analysis further, it is necessary to investigate the evaluation of individual questions.

10.3 Descriptive Statistical Analysis of the Scoresheets.

Having demonstrated that some association existed between grouped questions and overall evaluation scores, the individual questions were now subjected to a simple statistical analysis. This involved calculating the mean scores, standard deviations and skewness of the distribution of scores given for each of the 21 categories. The aim of doing so was to find which, if any, of the categories appeared to have some bearing on the evaluation of the two proposals. Therefore, it was of interest to identify categories which exhibited the following features:

(i) Categories which were scored highly positively or highly negatively, defined by high or low mean scores. These would represent items of information within each proposal which, by the consensus of the participants, were favourably or unfavourably evaluated.

(ii) Categories which elicited differing responses, defined by mean scores at or around zero, but with a large number of positive and negative scores contributing to this neutral mean score. It would seem likely that the items of information represented by these categories could be crucial in determining the outcome of the evaluation, since they represented differing views of 'good' and 'bad' in each proposal.

(iii) Categories which could be regarded as relatively neutral, defined by the number of zero scores given on the score sheets. Items of information such as these would probably not influence the eventual outcome of the evaluation to any great extent.

In order to identify questions of interest, high or low means, standard deviations and skewnesses were taken as being greater than one standard deviation above, or one standard deviation below, the mean score produced from the summation of each of these values.

Tables 10.5, 10.6 and 10.7 on the following pages present the results of this analysis. Tables 10.5.1 and 10.5.2 show a simple descriptive analysis (the number of people scoring each question, the total score for each question, and the mean, standard deviation and skewness calculated from this data for each question) for BIL and TRI respectively. Tables 10.6.1 and 10.6.2 summarise the information presented in tables 10.5.1 and 10.5.2, showing which values are of interest in this analysis. Tables 10.7.1 and 10.7.2 summarise tables 10.6.1 and 10.6.2, ranking questions in order from highest positive mean to lowest negative mean. In so doing, questions of interest are highlighted.

Table 10.5.1 Descriptive statistical analysis - BIL.

Category	Total negative Number	Total negative Score	Total positive Number	Total positive Score	Total positive and negative Number	Total positive and negative Score	Total neutral Number	Mean	S.D.	Skew	No score given Number
1	0	0	13	17	13	17	2	1.133	0.618	-0.093	1
2	3	3	11	14	14	17	2	0.688	0.982	-0.530	0
3	8	11	6	7	14	18	2	-0.250	1.250	0.096	0
4	7	10	3	5	10	15	6	-0.313	1.210	0.404	0
5	3	4	8	8	11	12	3	0.286	0.958	-1.080	2
6	9	12	2	2	11	14	5	-0.625	0.927	0.132	0
7	7	9	4	7	11	16	5	-0.125	1.269	0.419	0
8	4	5	5	9	9	14	7	0.250	1.199	0.163	0
9	10	15	0	0	10	15	6	-0.938	0.827	-0.117	0
10	9	13	7	7	16	20	0	-0.375	1.269	-0.006	0
11	6	9	2	3	8	12	8	-0.375	1.053	0.150	0
12	8	13	5	6	13	19	2	-0.467	1.360	0.248	1
13	6	8	6	6	12	14	3	-0.133	1.087	-0.356	1
14	11	16	0	0	11	16	4	-1.067	0.772	0.115	1
15	9	14	5	6	14	20	2	-0.500	1.323	0.324	0
16	5	9	5	7	10	16	5	-0.133	1.360	-0.076	1
17	8	13	4	4	12	17	4	-0.563	1.171	0.034	0
18	8	14	5	8	13	22	2	-0.400	1.583	0.371	1
19	3	5	11	18	14	23	2	0.813	1.379	-0.947	0
20	3	4	3	5	6	9	8	0.071	1.033	0.246	2
21	6	10	7	8	13	18	1	-0.143	1.407	-0.207	2
Mean	6.3	9.4	5.3	7.0	11.7	16.4	3.8	-0.151	1.145	-0.034	
S.D.	2.8	4.3	3.3	4.6	2.3	3.3	2.3	0.533	0.233	0.397	
Mean - SD	3.6	5.0	2.1	2.4	9.4	13.1	1.5	-0.684	0.912	-0.431	
Mean + SD	9.1	13.7	8.7	11.6	14.0	19.7	6.1	0.382	1.378	0.363	

Table 10.5.2 Descriptive statistical analysis - IRI.

Category	Total negative Number	Total negative Score	Total positive Number	Total positive Score	Total positive and negative Number	Total positive and negative Score	Total neutral Number	Mean	S.D.	Skew	No score given Number
1	3	5	10	14	13	19	1	0.643	1.342	-0.926	0
2	6	9	7	10	13	19	1	0.071	1.486	-0.123	0
3	2	3	8	10	10	13	4	0.500	1.052	-0.736	0
4	5	8	9	11	14	19	0	0.214	1.423	-0.529	0
5	5	6	5	7	10	13	4	0.071	1.163	0.134	0
6	8	14	3	3	11	17	3	-0.786	1.206	0.317	0
7	13	22	1	1	14	23	0	-1.500	0.824	1.917	0
8	12	21	1	1	13	22	1	-1.429	0.904	1.530	0
9	8	14	4	6	12	20	2	-0.571	1.498	0.520	0
10	8	10	3	3	11	13	3	-0.500	0.982	0.226	0
11	5	7	2	3	7	10	7	-0.286	1.030	0.200	0
12	3	5	5	7	8	12	4	0.167	1.280	-0.313	2
13	5	9	2	3	7	12	7	-0.429	1.178	0.091	0
14	8	12	1	1	9	13	5	-0.786	0.940	0.079	0
15	7	9	5	5	12	14	2	-0.286	1.097	-0.066	0
16	7	11	5	6	12	17	2	-0.357	1.342	0.138	0
17	6	9	3	4	9	13	4	-0.385	1.211	0.249	1
18	9	16	3	3	12	19	2	-0.929	1.227	0.567	0
19	2	4	11	17	13	21	1	0.929	1.334	-1.312	0
20	1	2	11	14	12	16	2	0.857	0.990	-1.479	0
21	8	10	4	4	12	14	2	-0.428	1.050	0.181	0
Mean	6.2	9.8	4.9	6.3	11.1	16.1	2.7	-0.249	1.169	0.032	
S.D.	3.0	5.2	3.2	4.6	2.1	3.7	1.9	0.648	0.188	0.776	
Mean - SD	3.2	4.6	1.7	1.8	9.0	12.5	0.8	-0.897	0.982	-0.744	
Mean + SD	9.3	15.0	8.1	10.9	13.2	19.8	4.6	0.400	1.357	0.807	

Table 10.6.1 Summary of descriptive statistical analysis - BIL.

Key
A = greater than one standard deviation above mean value for row total.
B = greater than one standard deviation below mean value for row total.

* = mean score for question is within +/- 0.250 of zero (designated as an overall neutral score).
x = value for skew is within 0.100 of zero (designated as indicating even distribution of scores).

	Total negative		Total positive		Total positive and negative		Total neutral	Mean	Rank (hi to lo mean)	S.D.	Skew
	Number	Score	Number	Score	Number	Score	Number				
Category											
1	B	B	A	A			B	A	1	B	x
2	B	B	A	A	A		B	A	3		B
3					A		B	*	11		x
4							A		12		A
5	B	B				B			4		B
6	A		B	B					19		
7								*	7		
8	B	B			B		A	*	5		
9	A	A	B	B			A	B	20	B	
10	A				A	A	B		14		x
11			B		B	B	A		13		
12							B		16		
13								*	9		
14	A	A	B	B				B	21	B	
15	A	A			A	A	B		17		
16								*	8		x
17									18		x
18		A				A	B		15	A	A
19	B	B	A	A	A	A	B	A	2	A	B
20	B	B			B	B	A	*	6		
21							B	*	10	A	

Table 11.6.2 Summary of descriptive statistical analysis - IRI.

Key
A = greater than one standard deviation above mean value for row total.
B = greater than one standard deviation below mean value for row total.

* = mean score for question is within +/- 0.250 of zero (designated as an overall neutral score).
x = value for skew is within 0.100 of zero (designated as indicating even distribution of scores).

Category	Total negative		Total positive		Total positive and negative		Total neutral	Mean	Rank (hi to lo mean)	S.D.	Skew
	Number	Score	Number	Score	Number	Score	Number				
1	B	B	A	A	A		B	A	3		B
2					A		B	*	8	A	
3	B	B	A			B		A	4		
4			A	A	A		B	*	5	A	
5						B		*	7		
6									18		
7	A	A	B	B	A	A	B	B	21	B	A
8	A	A	B	B	A	A	B	B	20	B	A
9						A			16	A	
10						B			15	B	
11			B		B	B	A		9		
12	B	B			B	B		*	6		
13			B		B	B	A		14		x
14			B	B	B	B	A		17	B	x
15									10		x
16									11		
17					B	B			12		
18	A	A					B		19		
19	B	B	A	A	A	A	B	A	1		B
20	B	B	A	A				A	2		B
21									13		

Table 10.7.1 BIL - interpretation of descriptive statistical analysis.

Categories ranked in order from high positive to high negative mean value	Assigned to variable	Mean value	S.D.	Skew	Remarks.
A. Questions scored positively.					
1. Value to the world.	Product	1.133	B	x	
19. Technical knowledge.	Management	0.813	A	B	Highly scored.
2. Demand growth.	Market	0.688		B	Highly scored.
5. Technological characteristics.	Product	0.286		B	Low score.
B. Question scored +/- 0.250 of zero.					
8. Government regulations.	Product	0.250			Low score, high number of neutral evaluations.
20. Management commitment.	Management	0.071			Low score, high number of neutral evaluations.
7. Product liability.	Product	-0.125	A		
16. Exit potentials.	Financials	-0.133		x	Highly scored, marked difference in evaluation.
13. Years to maturity.	Financials	-0.133			Highly scored, marked difference in evaluation.
21. Management team experience.	Management	-0.143			Marked difference in evaluation.
3. Availability of substitutes.	Product	-0.250		x	Highly scored, marked difference in evaluation.
C. Questions scored negatively.					
4. Price elasticity.	Financials	-0.313		A	High number of neutral evaluations.
11. Distribution system.	Market	-0.375			Low score, high number of neutral evaluations.
10. Market size.	Market	-0.375		x	Highly scored, indicates contrasting evaluations.
18. Profit and loss experience.	Management	-0.400	A	A	Highly scored, indicates contrasting evaluations.
12. Margins.	Financials	-0.467			Highly scored.
15. Percentage of market.	Market	-0.500			Highly scored.
17. Market barriers.	Market	-0.563		x	
6. Marketing and advertising strategies.	Market	-0.625			
9. R&D commitments.	Financials	-0.983	B		
14. Capital needed.	Financials	-1.067	B		

Table 10.7.2 IRI - Interpretation of descriptive statistical analysis.

Categories ranked in order from high positive mean value to high negative mean value.	Assigned to variable	Mean	S.D.	Skew	Remarks.
A. Questions scored above zero.					
19. Technical knowledge.	Management	0.929		B	Highly scored.
20. Management commitment.	Management	0.857		B	
1. Value to the world.	Product	0.643		B	Highly scored.
3. Availability of substitutes.	Product	0.500			Low score.
B. Questions scored +/- 0.250 of zero.					
4. Price elasticity.	Financials	0.214	A		Marked difference in evaluation.
12. Margins.	Financials	0.167			Low score.
5. Technological characteristics.	Product	0.071			Low score.
2. Demand growth.	Market	0.071	A		Marked difference in evaluation.
D. Questions scored below zero.					
11. Distribution system.	Market	-0.286			Low score, high number of neutral evaluations.
15. Percentage of market.	Market	-0.286		x	
16. Exit potentials.	Financials	-0.357			
17. Market barriers.	Market	-0.385			Low score.
21. Management team experience.	Management	-0.428			
13. Years to maturity.	Financials	-0.429		x	Low score, high number of neutral evaluations.
10. Market size.	Market	-0.500	B		Low score.
9. R&D commitments.	Financials	-0.571	A		Highly scored.
14. Capital needed.	Financials	-0.786	B	x	Low score, high number of neutral values.
6. Market and advertising strategies.	Market	-0.786			
18. Profit and loss experience.	Management	-0.929			
8. Government regulations.	Product	-1.429	B	A	Highly scored.
7. Product liability.	Product	-1.500	B	A	Highly scored.

10.3.1 Interpretation of the descriptive statistical analysis.

This simple statistical analysis does at first appear to bear out the earlier conclusion that TRI was more negatively evaluated than BIL. Overall, the mean value calculated from the scores given for all 21 categories was -0.151 for BIL and -0.249 for TRI.

Some areas of consensus appear to exist in the evaluation of the two proposals. For example, categories 1 (value to the world) and 19 (technical knowledge) were highly rated in both cases. Given the lack of technical knowledge admitted by the participants, it is interesting to speculate on why this positive evaluation should have been given.

One possible explanation links with the earlier finding of the chi-square tests, that product information is not associated with the evaluation score given for each proposal. In the light of this, it seems reasonable to suggest that, as long as the idea appeared plausible, the participants were willing to accept that the entrepreneurs were technically proficient and the product had merit. They have no way of assessing whether this was so to the same degree of certainty as they would assess, for example, the marketing or financial data provided in the proposal, because of their (in most cases acknowledged) lack of technical expertise. However, as this information does not influence their initial decision to proceed with the evaluation (perhaps for this very reason, that they did not feel confident in evaluating the technical aspects of deals), the participants could feel safe in accepting the information provided in the business proposal at face value.

There is a similar consensus regarding categories 6 (marketing and advertising strategies), 9 (R&D commitments) and 14 (capital needed), all of which were highly negatively evaluated. The interpretation is easier in this instance; both plans were fundamentally unattractive to the participants in these respects.

However, it is clear that for TRI the safety of the product (cartilage grown in tissue culture for use in plastic surgery) weighed heavily against a favourable evaluation. Both categories 7

(product liability) and 8 (government regulation) were highly negatively evaluated. This reflects the participants' concerns over law suits from possible side effects attributable to the product, and potential problems in realising the investment which might arise in the event of delays in regulatory procedures. BIL's product (the DNA sequencer) had neither of these drawbacks.

Overall, it would seem reasonable to surmise that, aside from these product safety aspects, the evaluation of the two proposals was quite similar, with neither being seen as preferable to the other.

For BIL, categories 3 (availability of substitutes), 13 (years to maturity), 16 (exit potentials) and 21 (management team experience) are highly scored, but with mean values close to zero. For TRI, categories 2 (demand growth) and 4 (price elasticity) similarly stand out. For the participants, these categories clearly represent the most contentious areas of each proposal. Why these items of information should have elicited opposing interpretations is difficult to say. They do however demonstrate the subjectivity of project evaluation, that is, given the same items of information, two different interpretations are possible.

Finally, categories 8 (government regulation) and 20 (management commitment) stand out in the BIL proposal as being relatively neutrally evaluated. For TRI, these categories are 5 (technological characteristics) and 12 (margins).

Table 10.8 below compares the mean values and standard deviations for the product, market, financial and management variables for BIL and TRI respectively. Because of the product liability and regulatory aspects of TRI, the assessment of the product variable was far poorer than for BIL. The market and management variables show fairly similar scores in both cases. It appears, however, that BIL was seen as the poorer proposition in financial terms.

Table 10.8 Comparison of mean values for product, market, financial and management variables.

	Product	Market	Financial	Management
BIL.				
Mean	0.259	-0.292	-0.509	0.085
S.D.	0.484	0.448	0.369	0.452
TRI.				
Mean	-0.343	-0.362	-0.294	0.107
S.D.	0.935	0.258	0.368	0.806

10.4 Comparison of the UK and US Evaluations of TRI.

As was stated in the methodology chapter and the introduction to this present chapter, one of the main reasons for using TRI proposal and the Cope Pence scoresheets was to compare the evaluation of this proposal by American and British venture capitalists. Table 10.9 compares the evaluation of the proposal on the 1 to 5 evaluation rating scale (Appendix 2.3) where 1 = 'proposal would not be considered' and 5 = 'proposal would be likely to receive financing'.

Table 10.9 Comparison of evaluation of TRI by UK and US venture capitalists.

	TRI (UK)		TRI (US)	
Evaluation	No.	Freq.	No.	Freq.
1	12	45.0	7	20.0
2	7	40.0	7	20.0
3	0	0	2	5.7
4	2	15.0	6	17.1
5	0	0	13	37.1
	21	100	35	100

One problem of comparing the evaluations further is that only risk and return scores are provided in Cope Pence's study. The score for the liquidity variable were omitted since they appeared not to

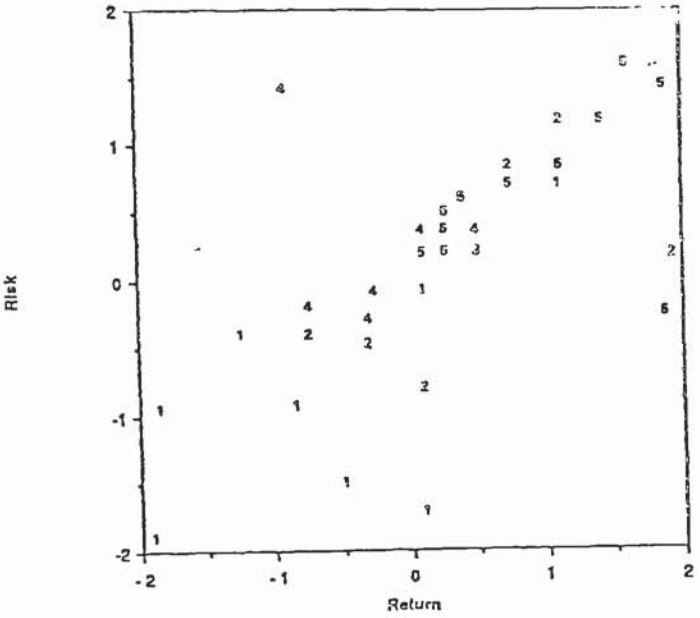
be linked to the overall evaluation score (Cope Pence, 1982:37). Consequently, a complete set of results are not available for comparison. In addition, because of the small number of scoresheets available, testing for any statistical significance in the difference between the UK and US evaluations was not possible. With this in mind, figure 10.1 (overleaf) presents scattergrams derived from the risk and return scores for each proposal, as obtained in the two studies. On the basis of these, some general comments can be made.

Table 10.9 shows that, in terms of its overall evaluation, TRI was more favourably reviewed by US venture capitalists. As was previously discussed in Chapter nine (section 2) a likely explanation for this is the geographic location of TRI, which would dissuade most British venture capitalists from reviewing the proposal further. That said, table 10.9 shows that 19 of the 35 US venture capitalists were enthusiastic about TRI, against just 2 UK participants. Moreover, 13 of these indicated that, bar any major problems in the subsequent evaluation, they would definately invest in the proposal. Again, as was suggested in Chapter nine, this may be accounted for by the biotechnology investment 'hype' which was then (1979) current in the US. At the time of this present study (1986), such opportunities were being viewed with far more caution.

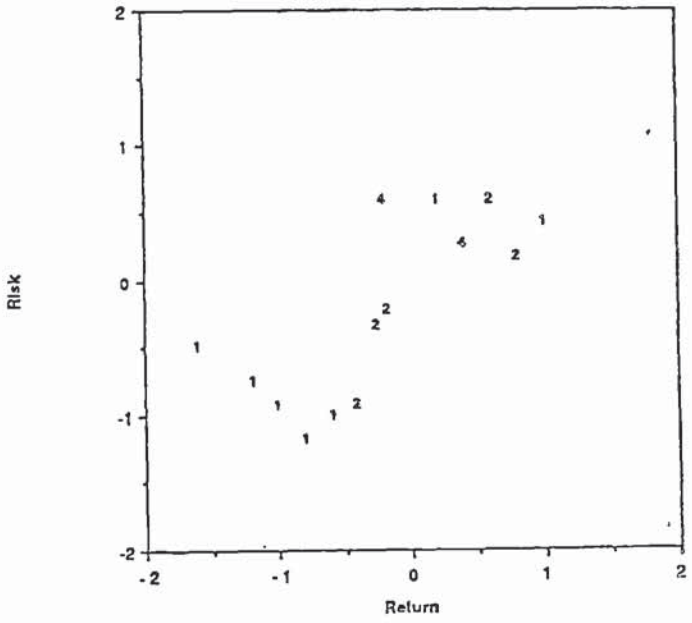
Figure 10.1 provides an additional, interesting insight into the evaluations of the proposal. In terms of the number of venture capitalists who gave TRI positive risk and return scores (that is, those whose scores appear in the upper right quadrant of the scattergrams) a little over 53% of the US scores appear in this quadrant, against just under 36% for those from the UK. These figures are almost reversed for negative risk/return scores (those appearing in the lower left quadrant), with 31.3% of the US scores and 57% of the UK scores appearing in this quadrant.

Figure 10.1 Scattergrams showing mean risk and return scores with evaluation score.

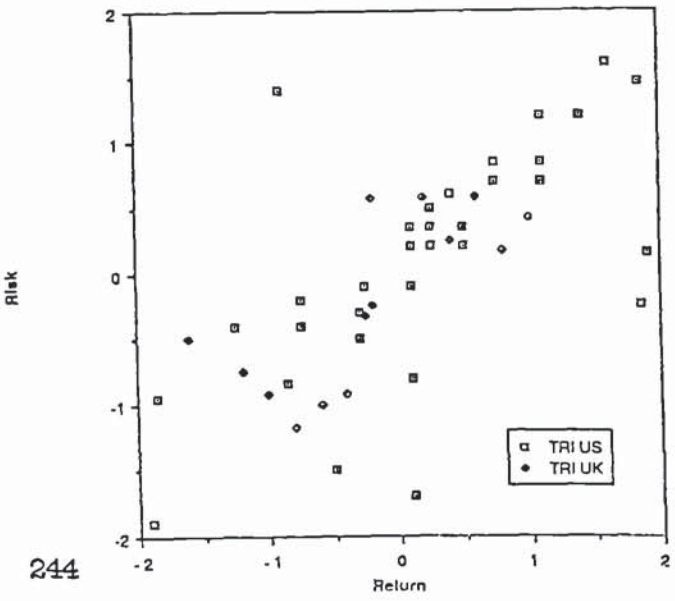
(i) TRI, US evaluation



(ii) TRI, UK evaluation



(iii) TRI, US and UK evaluations combined



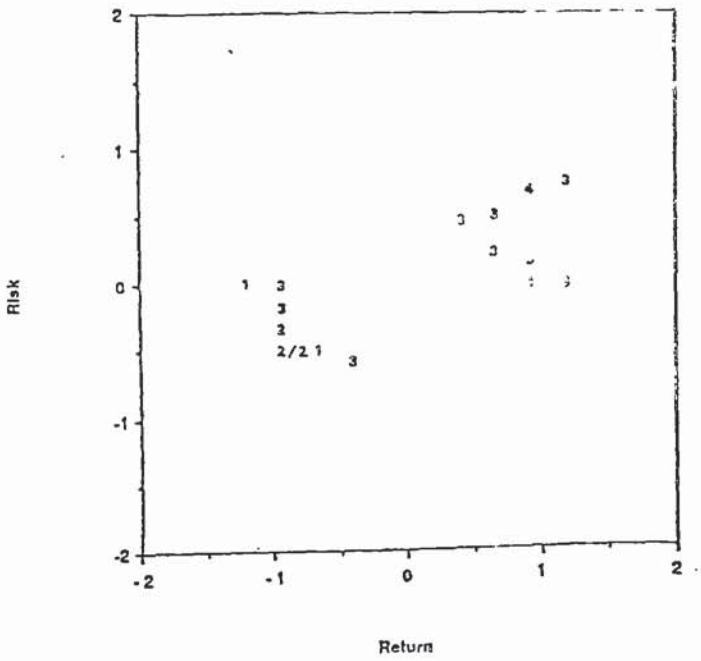
10.4.1 Interpretation of the differences between the UK and US evaluations of TRI.

It should be borne in mind that the US results were obtained by post-interview scoring of the scoresheets, whereas the UK scores were obtained at interview. Furthermore, whether these differences in the evaluation of TRI are in any way significant is difficult to judge. However, the results do suggest that, both in terms of its overall evaluation and the evaluation of its fundamental components (represented here by the risk/return scores), British venture capitalists responded less favourably than their US counterparts to TRI. Because of the latter finding, it would appear that the geographical remoteness of TRI is not entirely responsible for its poorer rating amongst UK participants. Whether this relatively less favourable response can be explained in terms of the biotech 'hype' influencing the US evaluation, or whether it is evidence of a more risk averse attitude amongst UK financiers cannot be judged. (Cope Pence does note that altruism and the wish to be associated with a product which was seen as being 'socially beneficial' influenced the evaluation of TRI in her study.) Certainly, given the time period which elapsed between the two studies, the latter conclusion would be at best tendentious. Only by obtaining evaluations of a proposal(s) at the same point in time could any relatively greater risk aversion on the part of UK venture capitalists be properly demonstrated.

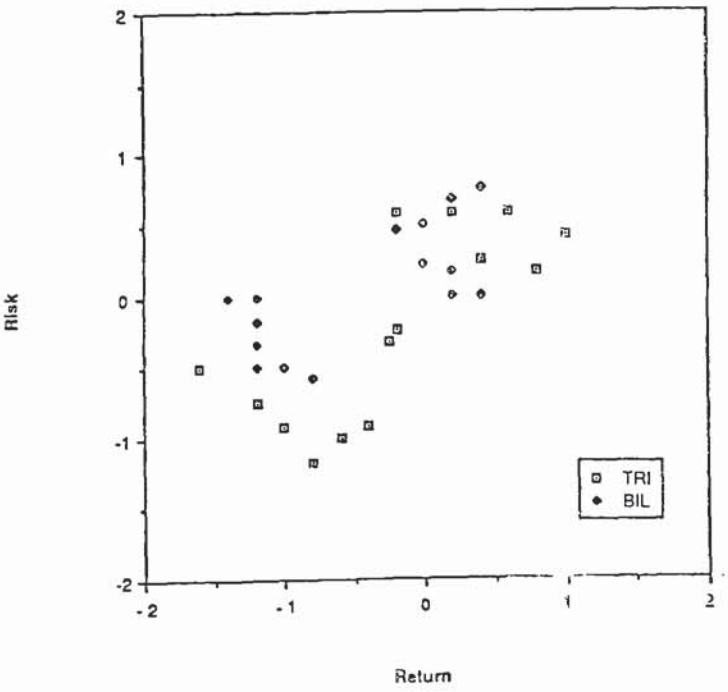
Finally, figure 10.2 (on the next page) compares the risk/return scores given for BIL and TRI in this present study. Again, BIL appears to be given the slightly more favourable evaluation, with 50% of the scores given being in the upper right quadrant of the scattergram. However, the two sets of scores appear so closely distributed that any difference does not appear to be significant.

Figure 10.2 Scattergrams comparing UK evaluation of BIL and TRI

(i) BIL evaluation



(ii) BIL and TRI evaluations combined



10.5 Summary.

The small number of scoresheets available severely constrained the analysis presented here. However, the following points may be made. There appears to be some association between questions on the scoresheets relating to market and financial aspects of the proposals and the overall decision to commit further resources to investigating them as investment opportunities. Product information affects this decision relatively less so, whilst management information appears not to affect it at all. Specific issues highlighted in both cases were the 'value to the world' of the project and 'technical knowledge' of the entrepreneurs, both favourably evaluated, and 'marketing and advertising strategies', 'R&D commitments' and 'capital needed', all of which were unfavourably evaluated. In addition, the product liability aspects of TRI were highlighted as a disincentive to investment. It should be noted that the questions surrounding the ability of BIL to manufacture the DNA sequencer, highlighted in the venture capitalists' evaluaiton of this proposal (Chapter nine) was not identified from the analysis of these scoresheets.

Finally, a comparison of the risk/return scores for TRI obtained in Cope Pence's US study and in the present investigation showed that UK venture capitalists gave this proposal a less favourable evaluation. This was so even taking into account the time differences between the evaluations. Whether this indicates that British venture capitalists are more risk averse than their US counterparts could not, however, be demonstrated.

CHAPTER ELEVEN

DEVELOPING AN ALTERNATIVE APPROACH TO UNDERSTANDING VENTURE CAPITALIST INVESTMENT DECISIONS

11.1 Introduction.

Chapter nine described attempts to understand the evaluation of the Brookfield Instruments Ltd. (BIL) and Tissue Reproductions Inc. (TRI) business proposals, by analysing comments made by venture capitalists on the two proposals. The aim of this analysis was to convert these comments into a form where they could be scored and analysed using standard statistical procedures. Chapter ten described a similar attempt to understand the evaluation, through the use of a predetermined scoresheet. For a number of reasons (described in the two Chapters) these analytical procedures were not fully successful in providing a clear understanding of the evaluation of the two proposals.

Recognising that this was so, an alternative approach to understanding how and why the proposals had received their evaluation was sought. This chapter outlines the development of this analytical framework and how it was applied. The 'holistic' approach described, which places greater emphasis on the individual evaluator's background, was not successful in explaining the formulation of the evaluation decision in this instance. Nevertheless, it is concluded that this approach seems to offer a method which might be successful in answering such questions and may, therefore, merit further development.

11.2 Shortcomings of the 'quantify' approach.

Figure 9.1 in Chapter nine presents a model for the analysis of the evaluation of the BIL and TRI business proposals. It will be recalled that the assumption of this model was that an analysis of the comments made on the proposals can lead to an understanding of how and why evaluation decisions are reached.

As the analysis of the evaluations of the BIL and TRI proposals progressed, it became increasingly obvious that both this analytical framework and the use of a pre-determined scoresheet (Chapter ten) were of limited use in explaining why the evaluation decision was reached. In general terms, the model was successful in identifying what items of information were chosen, how they were reacted to (whether they were perceived favourably or otherwise) and what degree of emphasis was attached to them in formulating the evaluation decision. However, it was markedly less successful in correlating these items of information with the overall decision. In addition, it could not explain why these items were selected nor why they were evaluated in the way they were.

The main problem encountered with the use of the Cope Pence scoresheet was attempting to extract meaning from them, given the small number available for analysis. In a sense, however, this was turned to some advantage as it forced the author to concentrate on a range of methods for interpreting the data. In doing so, a critical awareness of the limitations of using questionnaires in this type of research developed.

Some of these limitations have been described previously in the introductory comments to Chapter ten. To summarise the observations made there, it appeared that the categories of information (the questions asked) on the scoresheets only partly reflected the items of information chosen by the participants in their evaluation of the proposals. In addition, the content analysis and subsequent attempts to generate a scoresheet based on this analysis made plain that the possible interpretation which may be attached to a question (management skills, for example) varies widely from individual to individual. In summary, it is apparent that the evaluation decision being investigated here is highly individual and, as a result, presents fairly complex problems in its analysis.

11.3 The Complexity of the Evaluation Decision.

What emerges from the content analysis presented in Appendix four is that a wide variety of items of information contained within

each of the business proposals were selected in formulating (or justifying) the evaluation decisions made. The extent to which any of these items may be considered key determinants of this decision is, of course, more limited. In the first place the venture capital firms participating in this study each have their own deal screening criteria which will in turn influence which items of information may be chosen. Second, as table 9.8 showed, it is clear that usually some quite specific aspect(s) of the proposals can be shown to be directly linked to the decision to reject the proposal without further review. Third, implicit in the scoring system described in section 7.5 of Chapter nine, where 1 = absolute rejection and 6 = major acceptance of an item of information, is a recognition that some of these items are of only minor importance in formulating the decision. Finally, it must of course be recognised that at another time the participants may well have made a different set of comments about the two proposals. The only prediction that can be made with any degree of certainty is that they would have identified the same items of information as key determinants for their evaluation decisions. This is particularly true of the absolute rejection statements which were identified, these usually being deal screening criteria.

On the other hand, whilst it may be relatively straightforward to identify why a proposal is rejected, particularly when deal screening criteria are involved, it is far more difficult to identify why a plan is viewed favourably. In these instances, the key determinants of the investment decision are less clearly visible. This is so for two reasons. First, as has been stressed already, the evaluations received are individual in respect of the items of information identified. This means that in any single evaluation the items chosen, both in terms of why they were chosen and the relative weightings given to them, will depend on the individual evaluator. Attempting to decide what these weightings are purely on the basis of an examination of the comments made is clearly impractical. Second, the 'quality' of the evaluations varied from person to person, from those who assessed the proposal as acceptable or otherwise on very few items of information to those who looked at and gave an evaluation on many aspects of the

two proposals (as is shown in Appendix 4.1). Identifying the key determinants in the latter case is even more problematic.

One way of simplifying the analysis would appear to be that of simply stating that a plan which does not fail the screening criteria will be accepted. However, in this context screening criteria are essentially non-judgemental. Selection of items of information other than those relating to these criteria introduces elements of personal judgement into the evaluation process. On this basis the evaluation decision, particularly an affirmative decision, can be seen to result from an interaction between a constant, the proposal, and a variable, the evaluator.

This is perhaps best illustrated by the following example. It will be recalled that table 9.5 showed the statements made on the management team of TRI. Table 11.1 on the next page presents a summary of those statements, together with those for the management of BIL and the product in both instances. These aspects were rated simply as being 'good' and 'poor', where it was possible to describe the evaluations unambiguously as such.

What becomes apparent from table 11.1 is that, looking at and evaluating the same items of information, the participants in this study arrived at often contradictory evaluations. Taking into account both the individual nature of the items of information selected in the first place (see Appendix 4.1) - and perhaps equally important those items not selected - and their favourable or otherwise interpretation, it is not surprising that understanding the evaluation decision should prove so difficult.

It therefore became apparent as the data analysis progressed that an understanding of the evaluation decision could only be reached by taking into account the individuals involved. Any analysis would have to identify the reasons why they selected particular items of information and why they reached their evaluation decision. In summary, whether an item of information was chosen for evaluation and whether it was perceived favourably or otherwise cannot be seen simply as a function of that item of information, but rather, of its interpretation.

Table 11.1 Examples of Variance in the Evaluation of the BIL and TRI Business Proposals.

Venture Capitalist	Opinions of Management[1] BIL Good	BIL Poor	TRI Good	TRI Poor	Opinions of Product[2] BIL Good	BIL Poor	TRI Good	TRI Poor
1	+			-		-	+	
2				-	+			-
3		-				-	+	
4		-	+		+			
5				-				-
6	+				+			-
7	+			-				
8		-		-				
9				-		-		-
10								-
11				-	+			-
12				-	+		+	
13				-	+			
14		-	+					
15		-	+					-
16		-						-
17		-						
18		-		-			+	
19		-	+					
20		-	+		+			
21	+		+				+	
	4	10	6	10	7	3	5	8

1 - refers to perceived ability of management to successfully run a business.
2 - refers to the technical explanation and product description, ie. whether the product was understood on the basis of the information contained in the proposal.

11.4 The Role of the Individual in Investment Decision Making.

It would seem reasonable to assume that an approach which took into account the individual may in addition go some way to explaining the nature and basis for venture capitalist's 'feeling' or 'gut reaction' to business propositions. Such intuitive responses were reported in this study and have been described in other studies (Wells, 1974; Cope Pence, 1982). However, we might postulate that such reactions do in fact have a substantive basis.

A number of factors which influence the evaluation decision have already been mentioned in Chapter six, with some aspects of these factors being investigated in Chapter eight. It may be worth

re-stating what these factors are, as they specifically relate to the individual, and considering what additional factors may influence the individual's evaluation decision.

The first factor is the individual's past experience, which ranges from general academic history and employment track record to more specific knowledge of, for example, investments in similar companies. Related to this are two other factors, namely the personal appeal and understanding of the product or service on offer, and certain situational constraints - the ethos of the venture firm, the general investment climate at any place or time, and so forth. As was mentioned in the previous paragraph, these have been investigated in previous sections of this thesis.

A fourth factor, which has not really been addressed in this study, is the personality type of the individual. This includes the classic risk taker versus risk averse - type A or type B - personality. The personality type will also affect the way in which an individual is able to contemplate a series of differing outcomes arising from an investment decision - the breadth of vision of the individual - and to what extent the rating of these outcomes affects the determination of the potential for success against the pitfalls of an investment decision.

A fifth factor, related to the above, is how an individual processes information. People are affected by their different likes and dislikes, preferences and aversions. In the context of this present study it is likely, for example, that the way in which the evaluation is undertaken, if related to the individual's experience, means that attention will be directed towards particular aspects of the proposals.

Combined together, these factors provide a framework within which the venture capitalist approaches the evaluation. It follows from this that the information which was obtained from during the evaluation interviews can more correctly be described as the product of these individual approaches rather than a set of decision variables inherent within the plan. We may, therefore, ascribe the apparent complexity of the evaluations as resulting from the venture capitalists heuristics which:

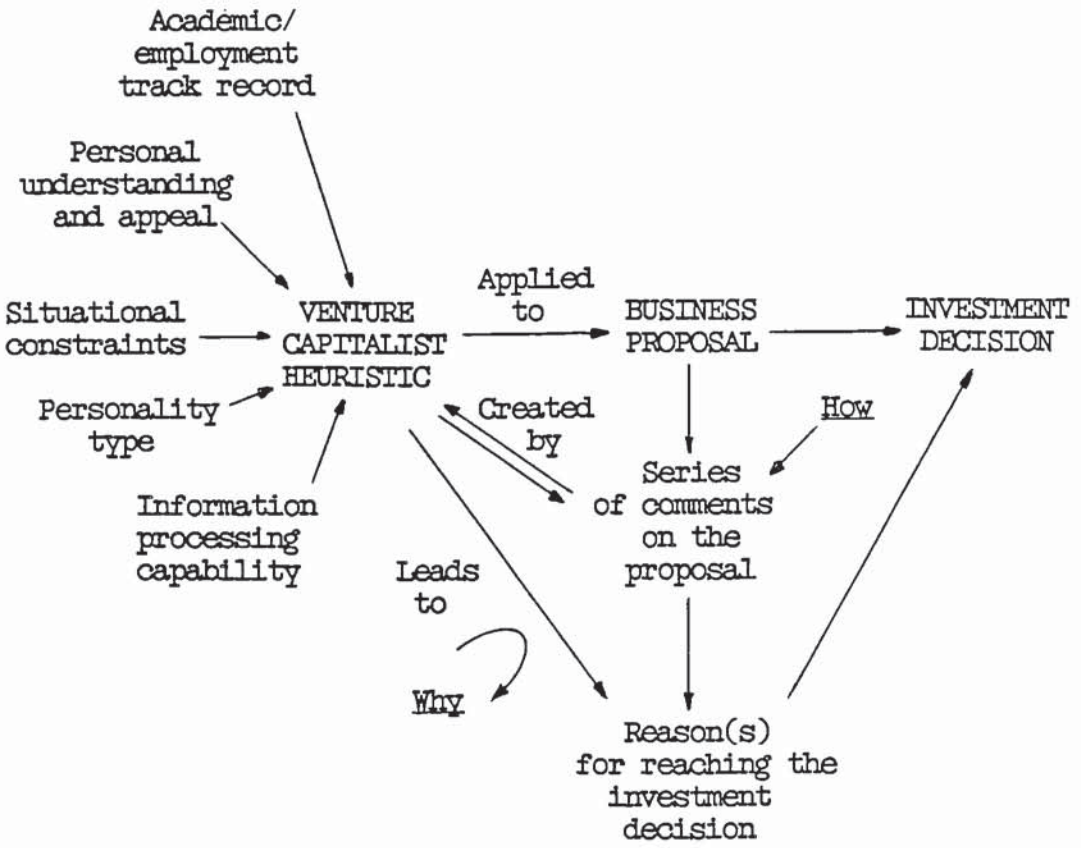
> 'are rule-of-thumb, problem-solving methods which often succeed but which do not guarantee a solution to a problem' (Kahney, 1986:45).

It is interesting to note in passing how this contrasts with the nature of the evaluation decision immediately prior to investment. Notwithstanding the deal structuring preferences of the individual venture capital firms involved, it is likely that the final decision to commit funds is based on fewer variables than the initial decision to proceed further with the investigation. In other words, the later stage decision is less complex, with more features in common between firms, and hence such decisions may be more amenable to quantitative analysis. The evaluation process may, therefore, be seen as replacing the initial heuristic-based assessment with a more conventional risk-return assessment of the investment opportunity, as the venture capitalist attempts to structure a deal which as closely as possible resembles a 'conventional' investment opportunity. In other words, unmeasurable uncertainty is progressively replaced by measurable risk.

11.5 An Holistic Approach to Understanding Venture Capitalists Investment Decision Making.

The conclusion reached on the basis of the above discussion is that, if the initial decision to further investigate a proposal is to be understood, an alternative model for the analysis is required. This model is presented in figure 11.1 on the next page. In placing a greater emphasis on the evaluator, in particular the elements involved in constructing the individual's heuristic, rather than looking simply at the evaluation, this 'holistic' approach sees the comments on the two proposals arising from an interaction between the evaluator's heuristic and the proposal being evaluated. In essence, the heuristic provides the context for the comments.

Figure 11.1 Model for the Holistic Analysis of Venture Capitalist's Evaluations of the TRI and BIL Business Proposals.



11.6 Limitations to Applying the Holistic Model.

Because this model arose from observing the limitations of the original approach - which sought to understand venture capitalist decision making solely on the basis of comments made on the proposals - there are in turn a number of limitations to developing the holistic model in this present study. These are as follows.

First, it should be remembered that this study was originally designed to discover how the technological aspects of business proposals affect the overall evaluation of technologically orientated - in this case biotechnology-based - business proposals. This encompasses such questions as how is the technology evaluated, where does it fit with the overall evaluation decision and why the technological aspects of such

proposals are so perceived. Discovering why evaluation decisions are made provokes new questions, which were not addressed here.

Second, there is the lack of an adequate theoretical framework to fully support the model. Although a large body of literature exists on the behavioural aspects of decision making under uncertainty, it was not possible to address this adequately in this present study. Had a need for a behavioural approach been identified earlier, a different interview schedule could have been used to investigate in more depth issues pertinent to the construction of individual participant's heuristics, namely the nature of their motivations, attitudes and biases.

Third, had this approach been adopted from the start, the interviews, of necessity, would have been conducted using a more interventionist approach. However, from the data available we cannot state why, for example, an individual may have perceived the management team of either of the proposals as 'good' (or 'bad'). It would have been necessary to return to the interviewees - or conduct a series of new interviews - which may have clarified such matters as these. But just as an understanding of the heuristic is necessary to the understanding of why an individual reaches an evaluation decision, likewise an explanation of why such comments were expressed is necessary to attain a complete understanding and description of an individual's heuristic.

Fourth, it is envisaged that the type of analysis appropriate to a study such as this would involve comparative case studies. To perform properly, such a study requires a considerably different approach to the one adopted here (see, for example, Yin, 1984), which was not designed to address such issues. In any event, it did not prove possible to force-fit the information that was available into such a format.

In summary, it must be emphasised that, although attempts to understand the venture capitalist's decisions on the basis of the model presented above were unsuccessful in this instance, this is due to the fact that the study was designed to address certain specific questions; the data thus generated could not be force-fitted into an analytical framework developed subsequently.

Discovering the answer to why venture capitalists reach their decisions will no doubt prove extremely difficult. This would of course be true of any investigation of personal preferences where such a small population is available for field study. But the conclusion which emerged from this research was that, without a theoretical framework developed from such investigations, the assumptions underlying questionnaire or survey-based approaches are, in the author's opinion, highly dubious.

The remainder of this Chapter describes attempts to analyse the evaluations in the light of the holistic model. Although unsuccessful, they may prove useful in indicating the potential approaches and drawbacks of this type of analysis.

11.7 Seeking Links Between the Heuristic and the Evaluation.

The first approach adopted modifies the earlier analysis of comments, made in response to the questionnaire shown in Appendix 2.1, on venture capitalist's backgrounds, attitudes to investment and so forth (presented earlier in Chapter 8) and those made on the evaluation of the two proposals. In both cases these comments had been reduced to a series of discrete statements in order to simplify their interpretation (as described in Chapter 9). For the purposes of this present analysis, these statements were grouped together under a number of general headings. For the venture capitalists, these included age, qualifications and experience of the interviewee, evaluation bias, reasons for rejecting proposals, evaluation of technology, exposure to biotechnology projects - all the information available from the interview transcripts and any supplementary material which was available for constructing the individual's heuristic. These were listed on one half of a sheet of A3 paper.

On the other half the statements made on each of the proposals were listed, again under general headings such as management, marketing, product and so forth. Connections between the two were then sought.

In one analysis, that of the evaluation of BIL by venture capitalist 01, the suggestion emerged that the participant was not making a decision. Although a number of judgements were made on items of information contained within the proposal it appeared that, because the plan met the firm's deal screening criteria, it was let through. It was thought that this could be linked to this participant being a relatively junior member of the firm. However, a similar deduction could not be made from the analysis of the TRI evaluation. Furthermore, in the analysis of four more venture capitalist's evaluations, even conclusions as tentative as this could not be drawn. Quite simply, without re-interviewing the individuals concerned, there was no way of finding why certain statements were made. Unfortunately, therefore, despite repeated attempts to gain some kind of consistency in this analysis, this attempt failed to produce any conclusions which were other than highly subjective and impressionistic, and subject to such a degree of investigator bias as to be considered invalid.

11.8 A Case Study Analysis of the Evaluation Decision.

The second approach adopted involved the construction of a set of case studies. Three types of investor were identified based on evaluation biases and preferences expressed at interview. These were firms exhibiting primarily either a financial, technological or industrial orientation. A description of a representative firm of each type was prepared. From this an appropriate risk reduction strategy was deduced which was then applied to the evaluation of the proposals.

11.8.1 Case 1: Company with financial orientation.

11.8.1.1 Background to the company.

Venture capital firm 01, the development capital arm of a long established merchant bank, was formed in 1980. In 1985, it had a portfolio of 12 investments. Of these, 4 were start-ups, 3 were development financings and 5 management buy-outs. It had no investments in biotechnology.

Aside from funds obtained from its parent organisation, it also manages funds for financial institutions, stock market investors, pension funds and private individuals.

The firm has a management staff of 8. One of the two directors has senior industrial and consultancy experience in the public and private sector. Of the remainder, two are qualified accountants, the others have banking experience. Their experience is exclusively within the financial sector, in high technology and small firm project financing. The interviewee had two and a half years experience in venture capital funding.

11.8.1.2 Investment preferences.

Although the firm does have investments in start-up companies, its preference is for later stage investments. Start-up financings are only undertaken if there is an exceptional chance of success, if the investee is perceived to be a lower risk case than is the norm. It was stated that exceptionally an investment may be considered which is of a higher risk than normal, provided the firm's own money was being put at risk: '... just occasionally we might do one which is more of a P.R. exercise or more of a philanthropic exercise, but that's very rare.' As a general rule, the firm looked for companies to invest in, not projects to build up. It did not see its job as being one of, for example, building up a management team.

11.8.1.3 Evaluation preferences.

This preference for later stage investments was reflected in the evaluation bias of the interviewee. These were stated to be, first, what experience the management had and second, what the company had achieved in the past. Nearly all of the evaluation was undertaken in-house, with access available to both specialist analysts and detailed information sources in other divisions of the bank. 'Anything that can be compared to a quoted company - someone will know the ins and outs.' In addition, the major reasons for rejecting a proposal, aside from deal screening criteria, were stated to be management, particularly financial management. A promotional brochure states: 'We are backers of

people in priority to products or other factors. This is one criterion which we are not willing to waive'. Academic entrepreneurs were identified in particular as often having little or no business experience and as being unwilling to relinquish control of their development or invention. It was also indicated that sales and marketing were key factors in the evaluation.

11.8.1.4 Dealing with technical aspects of proposals.

The evaluation of the product involved in a project was ranked relatively lowly overall, at least at an initial stage: 'It's very hard to look at products if you're not a specialist in the area, to see if the product is a dynamic breakthrough or just a re-hash of something that's been done before - you just don't know.' This was reflected in the attitudes expressed concerning the technical aspects of proposals. The company had no industrial sector preferences and investments were not restricted to high technology ventures. The evaluation team had no technical expertise on board. The interviewee had a first degree in a technology-related subject, and tended to review proposals related to this subject. However, it was stated that, because many of the products or services in the proposals received were totally new, it was impractical to have specialist expertise in-house. Rather, understanding of particular areas tended to build up as a result of reviewing proposals from a particular sector. If this expertise was insufficient, an informal network of contacts was available to provide an explanation of the technical aspects of a deal. Recourse to formal assessments by external consultants was rare.

11.8.1.5 Attitudes to biotechnology.

The interviewee had no qualifications or experience in biotechnology. Given that less than 10 biotechnology-related proposals were received each year, there would have been little opportunity to develop an understanding through 'hands-on' evaluation of proposals. Indeed, the interviewee admitted this lack of experience. However, the following attitudes towards biotechnology investments were reported.

(i) In general, the higher the risk of a proposal, the higher the return expected. For biotechnology, whilst there were a few occasions when the returns had been, or would be, absolutely astronomical (the example given was an AIDS cure) more often than not the returns that could be expected from an investment were not commensurate with the risks involved.

(ii) Often, biotechnology projects were linked with an academic institution, making questions such as ownership of the technology 'awkward'.

(iii) Biotechnology projects are often associated with high equipment costs, which were seen as being difficult to recoup in the event of failure and liquidation of the company.

(iv) Biotechnology ventures were either total successes or total failures. Years of research and investment could lead nowhere.

(v) Biotechnology was looked on with suspicion, as it had so often failed in the past.

11.8.1.6 Summary of firm 01's investment strategy.

Venture capital firm 01 goes about its primary remit, of obtaining the maximum possible return on its investments, by adopting the following risk-reduction strategy. First, its preference is for established firms with a track record - companies which in many respects resemble their investments in quoted securities. Second, the technical aspects of proposals are not understood and are associated with increased risk and are, therefore, not important in the early part of the evaluation.

11.8.2 Case 2: Company with technological orientation.

11.8.2.1 Background to the company.

Venture capital firm 10, a specialist venture capital fund, was established in 1983. It had made seven investments as of August 1986. Four of these were development financings, of the remainder one was a start-up, one a management buy-out and one a rescue financing. At the time of the interview, the firm had two investments in biotechnology or biotechnology-related projects.

The seven management staff have a wide variety of industrial and commercial experience, ranging from financial and consultancy through to research and development, at senior manager and director level. The interviewee had been with the firm for 18 months, following a number of years experience as a manager and director of a number of companies within a well known industrial group.

11.8.2.2 Investment preferences.

The aims of the firm, as set out in its promotional material, are:

(i) to assist emergent and developing high technology companies by making available both finance and management advice;
(ii) to contribute to the development of high technology industries in Britain.

Although investments are restricted to high technology opportunities, no preference was expressed for any particular industrial sector. There was, therefore, no sector specialisation.

The firm seeks to invest in ideas which exist as a developed prototype, where finance is needed to assist the commercialisation of the product. Therefore, the firm does not provide prototype development (seedcorn or early start-up) finance, and this is reflected in its investment portfolio. However, it was stated that the firm '... has altruistic motives. In addition to being venture capitalists, [the firm] was set up to help UK ideas and UK inventions in the manufacturing sector.' Indeed, the firm stood out amongst those interviewed in the degree of proactive involvement which it had with its investee companies. As was previously recorded in Chapter eight, p.194:

> '[The firm] is unusual in that we're not over-concerned with the strength of the existing management team. A lot of venture capitalists will in effect back people; unless they've a belief in the founder and his team, no matter how good the product is, they'll shy away from investing in it. We take the reverse view. Providing the technology and the market looks right, because of our proactive style we believe we can find the management to make it all work. We're one of the very few. A number of funds claim to be interested in

> hi-tech but, having evaluated the product, still rely on a strong management team to develop the business, so as venture capitalists they spend little time with the business providing guidance only, whereas we actually work with the business.'

This involvement takes the form of providing active management participation in the investees, by visiting the investees at least once weekly. Because of this, the firm's staff had considerable track records of success, at senior management and director level, in technologically-orientated business environments.

11.8.2.3 Evaluation preferences.

The firm seeks to add value to its investees through this proactive investment preference: they are investing in the technical and creative expertise of the founder. However, it was stated that the evaluation of investment opportunities was more stringent than that of other venture capital firms, that they were more cautious in their evaluation. The firm also took substantially higher equity stakes in their investees than is the industry norm. In five of its seven investments, the firm had a controlling equity stake. The major reasons for rejection were stated to be the technology not being unique, the market for the product being too small, or the investees being one product companies.

11.8.2.4 Attitudes to biotechnology.

There was no in-house biotechnology expertise although, as previously mentioned, the firm did have two biotechnology-related investments. The interviewee did not see biotechnology as being any different from other high technology investments. The firm sees its role in the development of biotechnology limited to one of providing finance. The firm does not perceive any role for itself in the development of biotechnology, rather, its role is one of a financier. This is despite its avowed interest in promoting new technology.

11.8.2.5 Risk reduction strategy.

(i) The entrepreneur has borne the risk of developing the product.
(ii) The firm exerts a hands-on controlling interest in its investees, both financially and managerially. This allows the firm to add value to its investment and, at the same time, shape the development of the investee to the best advantage of the investor.
(iii) The firm is technologically biased, but the product is irrelevant, given there is no sector specialisation. This apparent contradiction may be explained by the firm's stated altruistic intent, namely the role it perceives for itself in assisting the development of new technology. It must of course be remembered that this means that any new high technology may be supported.
(iv) The firm appears to be an overt risk taker, but adopts a covert risk reduction strategy through a stringent evaluation and through controlling interests in its investees.

11.8.3 Case 3: Investor with Industrial Orientation.

11.8.3.1 Background to the company.

Venture capital firm 08, established in 1981, is an independent business expansion scheme (BES) fund. As of 1986 the firm had made 36 investments. Although none of these were in biotechnology or biotechnology-related companies, it was indicated that the firm was keen to have a presence in this area. It had examined a number of potential investment opportunities and had made offers to invest, but these had been turned down.

The management team of five all have extensive managerial and director level experience across a range of major, technology-orientated, public corporations. The interviewee had previously been president of a well known industrial group.

11.8.3.2 Investment preferences.

As with any fund, but particularly BES funds because of the pre-set time scales for investor returns, a key element in determining the investment preference of firm 08 was the timescale to investment realisation. For this reason, the majority of its investments were development financings, although it had supported a number of start-ups. One interesting aspect of this firm was that it sought to promote early industrial interest and, if possible, participation in its investees as one way of building relationships with existing companies who may be interested in buying out the investees as an option for realisation.

Relative to most of the other interviewees, the firm appeared to have fairly stringent reporting requirements. The venture capitalist on the investee's board makes a monthly report on the investee's progress. Monthly, quarterly and annual financial budgets and reports, which the firm assist in preparing, are required. The firm will become involved with an investee as necessary, and may assist in 'head hunting' - it has in the past teamed up experienced executives with its investee companies. There is, therefore, some degree of proactivity - the firm certainly sees itself as such, its approach being a 'business rather than a banking approach to small company development', although the firm's promotional literature emphasises that it does not get involved in the day-to-day running of its investees.

11.8.3.3 Evaluation preferences.

Firm 08 adopts a highly mechanistic approach in its evaluation, making use of a highly structured 'key investment criteria' checklist (see section 3.9 of Chapter 8 for further details of this), 'phases' in the evaluation procedure, segmentation of evaluation responsibilities amongst the management team and so forth, making this the most stylised approach of any interviewee. The aim of this approach to evaluating opportunities is to eliminate as far as possible individual subjectivity in the evaluation of projects.

The evaluation is from an 'industrial' perspective. This was defined as market size and share, the degree of competition and other fairly general, standard investment criteria. On the checklist used, emphasis is placed on the investee company being a business rather than a product, a company which is currently profitable, the presence of a competent and complete management team and a role for post-investment involvement. Management are seen as extremely important, one of the first checks being on the management of a potential investee.

11.8.3.4 Dealing with technical aspects of proposals and attitudes to biotechnology as an investment opportunity.

The approach to high technology is that the firm is 'comfortable' with these. The firm has recourse to a wide range of semi-formal external contacts from whom advice can be sought. A comment made on the evaluation of TRI indicates that the product is not important, they want a business to invest in.

Biotechnology is seen as being no different from any other investment. All investments are seen as being high risk.

11.8.3.5 Summary of investor's risk reduction strategy.

The firm operates a highly mechanistic deal screen. This involves considerably more checks than a normal deal screen, but may be considered as one way of converting uncertainty into risk. In terms of its relationship to its portfolio companies it considers itself to be fairly proactive, more so than firm 01 but less so than 08. The firm relies on the extensive managerial experience of its partners to manage the post-investment phase. It is a generalist investor, not restricted to high technology investments, which it considers itself comfortable with. Although difficult to quantify, the impression is, as stated by the firm, that they do look at investments from a management, not a financial, perspective.

11.8.4 Evaluation of the two proposals.

As a first measure of the venture capitalists reactions, we can look at the overall ratings given for the two proposals, as shown in table 11.2 below.

Table 11.2 Evaluation scores for BIL and TRI given by venture capitalists 01, 08 and 10.

	Venture Capitalist 01		08		10	
	Proposal BIL	TRI	BIL	TRI	BIL	TRI
Evaluation (1)	3	1	1	1	1	1
Reason for rejection (2)		A	B	B	A	A
Impressions of plan (3)	2	3	3	2	3	1

(1): 1 = Proposal will not be considered further
3 = Proposal would be reviewed more carefully and phone calls made

(2): A = Although the project is interesting in itself, it does not meet portfolio or other requirements
B = There are major inherent shortcomings in the project which make it an unattractive investment proposition

(3): 1 = Plan was poor compared to other proposals received
2 = Plan was below average compared to other proposals received
3 = Plan was average compared to other proposals received

It is clear that these three venture capitalists were not especially impressed with either investment candidate.

A second measure of the venture capitalists response can be obtained from the content analysis described in Appendix 4.1. If the three case study models are correct we would expect, for example, that venture capitalist 01, whose firm has a financial orientation, to concentrate on financial issues. Table 11.3 on the next page summarises the content analysis for the evaluation of the two proposals by the three participants.

Table 11.3 Allocation of statements to categories: venture capitalists' 01, 08 and 10 evaluation of BIL and TRI.

	Venture Capitalist					
	01		08		10	
	Proposal		Proposal		Proposal	
	BIL	TRI	BIL	TRI	BIL	TRI
Category	No.	No.	No.	No.	No.	No.
Management	1	5	8	3	1	3
Marketing	4	2	3	5	1	4
Product	8	9	3	4	2	5
Finance	6	6	7	12	3	3
Competition		1	2		1	3
Ownership of product	1	1	1		2	2
Stage of company development	5	1	2	3	1	
Comments on plan	2		1	1		1
Geographic location		2		2		1
Product liability		3		2		3
	27	30	27	32	11	25

It is difficult to derive from this data any clear patterns or trends which could be explained by the case study models. This is in no small measure due to the problems previously noted, of putting highly individual evaluation statements into a structured format such as this. Table 11.4 on the next page provides a further illustration of this problem. It was part of a third analytical framework, also unsuccessful, of comparing venture capitalists comments on the same item(s) of information in each proposal in order to try and understand further the nature of the evaluation decision. Although this proved useful in showing just how varied the evaluations were, it did not provide any insight into why these statements were made. Furthermore, these common statements represent only a minority of those made by each individual.

In the light of these problems, it became necessary to approach a case study of the individual evaluations as well. What became apparent in doing so was the difficulty of constructing cases which truly reflected the evaluations given. Because of this, little will be served by describing the attempts at analysis in full, other than to emphasis that they constituted a considerable time commitment with little tangible result. Part of an attempted

Table 11.4 Comparison of comments made on selected features of Brookfield Instruments Ltd by venture capitalists 01, 08 and 10.

	Venture Capitalist		
	01	08	10
Comment			
Management skills	Management have the types of skills needed.	No competent or complete management team.	
Stage of company development	Already an up and running business. Already a sales and service company - they have this existing business to fall back on.	Company isn't currently a profitable one.	They remain basically a distributor of US equipment.
Sales to manufacturing switch	Sales to manufacturing switch - has worked in the past. By implication they have manufacturing experience. They originally intended to make this switch.	Risks of going from sales and marketing to manufacturing are considerable, particularly if they have no manufacturing experience.	
Financial information	Not an investor's document. But it's quite usual for the financial information to be inadequate.	No historical performance. No idea how the company was doing until now. Forward projections are too short	Major problems with the financial data destroys the credibility of the document as a serious business proposal.
Ownership of technology	Interesting to know why Southampton gave them exclusive manufacturing rights.	Licensing arrangements with Southampton are far too onorous. They need harder negotiation.	Concerned that the technology is owned by Southampton.

analysis of the evaluation of TRI by the three participants will serve as an example of the problems encountered.

11.8.5 Case examples of the evaluation of TRI.

TRI was rejected by all three participants on the basis of deal screening criteria, namely that it was US based and at too early a stage of development. However, opinions on items of information contained within the proposal thereafter showed considerable diversity.

Venture capitalist 01's style was to acknowledge both the strengths and weaknesses of the proposal. So, for example, whilst this participant's overall opinion of the management team was that they were 'scientists not businessmen', it was also recognised that they had made a considerable financial commitment to the venture and they were at least aware of the need to market the product.

A second feature of this participant's style was the non-critical nature of many of the comments. Consider, for example, the following statement; 'Programme of acquisition mentioned - how will they carry that out'. This item of information was identified as a point which would require further clarification. In contrast, other participants were critical of the entrepreneurs for identifying this long-term aim as too ambitious for a small firm. Venture capitalist 01 was at least prepared for the venture capitalists to explain their reasoning.

A third interesting point is that concerning the model constructed for this venture capitalist's evaluation. It was considered that this would be approached from a financial perspective. The relevant statements made on this subject were as follows: the plan was not looked at from an investor's point of view; the figures as presented are quite hard to analyse; there was no funding structure; no exit route or mechanism for investment realisation was indicated; and no rate of return on investment was made explicit. However, this participant tempered these criticisms with the acknowledgement that it was quite usual for this to be the case, that it was quite usual for financial information to be

inadequate in this type of plan. This is in contrast to venture capitalist 10 who, aside from deal screening criteria, effectively rejected both proposals because of poor presentation of financial information.

Venture capitalist 10's evaluation of the two proposals was one of the most judgemental and highly critical of those obtained in this study. The first statement made was; 'Is Tissue Reproductions a total con?', which set the tone for the remainder of the evaluation. The evaluation of items relevant to this venture capitalist's preferences reflected this overall disbelief in the seriousness of the proposal. For example, where venture capitalist 01 wanted to know where the venture capitalists would publish their findings, venture capitalist 10 was highly critical that a bibliography or copies of these reports were not made available, or were not indicated. Again, where venture capitalist 01 questioned what rights or obligations were attached to the foundation grant, venture capitalist 10 went one stage further and questioned who, in fact, owned the proprietorial rights to the product and assumed that it was not solely the management team.

Perhaps what differentiates the evaluations provided by these two participants the most was that the latter's (venture capitalist 10) was far more 'in depth'. For example, spelling errors were identified as a source of irritation. This may account for one of the surprises of this participant's evaluation, in respect of the model built for it, which was the depth of the analysis carried out on the financial data of both proposals. It was by far the most analytical of any of the participants and identified a number of anomalies and mistakes in both cases.

As mentioned above, in contrast to venture capitalist 01, this participant placed a degree of emphasis on this financial evaluation which was sufficient to reject both proposals immediately, had they not already been rejected on the basis of deal screening criteria.

Venture capitalist 08's evaluation style was intermediate between that of participants 01 and 10. Again, rejection of TRI was on the basis of deal screening criteria, the company being considered a

start-up and because it was US based. It also failed on this firm's internal 'investment criteria' checklist on the basis of TRI not being an operation of scale and not having an adequate management team. The remainder of the items of information identified, as indicated above, were evaluated with a mixture of the critical approach of venture capitalist 10 and the non-critical comment approach of 01.

An interesting point which emerged was the contrasting interpretation of items of information. Venture capitalist 01 saw TRI's cloned elastic cartilage as the first of a series of products and accepted it as such. Participant 08 wanted to know what these follow-on products were. As previously stated, venture capitalist 10 considered the product to be a 'total con'. 08 identified the acquisition programme as an item of interest but, in contrast to 01, saw this as indicating that the cash requirements of the business were running away from themselves. Such a comment mirrors the critical comment approach of participant 10.

In summary, the evaluations presented here do not fit the model constructed for the evaluation. Venture capitalist 01 did not reject the plan on financial grounds, which would have been expected. Venture capitalist 10, despite a professed technical bias, undertook the most detailed financial analysis of any participant and rejected the plan on this basis. Venture capitalist 10 appeared to reject on deal screening criteria, these being more extensive for this firm than in the other cases.

11.9 Conclusions.

From the descriptions of the analyses provided, it should be apparent that, beyond the pre-determined screening criteria, a number of statements were made which influenced the evaluation decision. It was not possible, however, to identify which of these would have been key determinants of the decision. Certainly, the answers obtained did not fit the predictive model shown earlier. To this extent, this study was unable to show why venture capitalists picked particular items of information and why they reached their decisions. In summary, aside from presenting a

straightforward recitation of the venture capitalists statements on the two proposals, the case study frameworks which were pursued here fell down because of their inability to convey the complexity, context and subtlety of the evaluation. Had more time been available to develop and apply some other analytical framework, or to have conducted further interviews taking into account the findings of this thesis, it may have been possible to gain more insight into the venture capitalists decisions. Within the limitations of this present study, this could not be done. Nevertheless, it is hoped that some of the suggested approaches outlined here might be followed through in further studies of this type. This type of qualitative research requires considerable pre-planning and a highly creative approach. Miles and Huberman (1982) may provide a useful starting point for such a study.

CHAPTER TWELVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

12.1 Introduction.

This final Chapter outlines the main findings of this research and makes recommendations for further studies based on these conclusions. The findings themselves arose, first, from the literature-based investigation of the venture capital-biotechnology interaction (presented in Chapters three through six) and, second, from the field research of venture capital investment in biotechnology (described in Chapters eight through eleven). For convenience, the findings will be summarised under these two general headings.

12.2 Findings of the Literature Survey on the The Nature of the Venture Capital-Biotechnology Interaction, and the Role of Venture Capital in the Development of Biotechnology in Britain.

12.2.1 The funding of new biotechnology firms in America.

The first point of focus for this thesis was the new biotechnology firms (NBFs) established in America in the late 1970s and early 1980s. The aim was to identify factors which could account for why they received the backing of venture capitalists. This was of interest to the development of this thesis for the following reasons.

First, the NBFs established and confirmed the commercial opportunities offered by the new techniques of biotechnology. Second, they were instrumental in building up America's dominant lead in the exploitation of biotechnology. Third, they confirmed the perception of the US as being more dynamic, more entrepreneurial and more successful in taking advantage of the new technology than its competitor nations. Fourth, they also reinforced the perception of US venture capitalists as being technologically literate risk takers. Fifth, the high profile they

attained, and the success they had, in developing biotechnology provoked the interest of other countries and put biotechnology on the international science and industrial policy agenda. Sixth, and of particular relevance to this thesis, both they and the small firms active in developing semiconductor-based industries in America focussed attention on, and provided a role model for, the private sector development of new technology in Britain. Seventh, and finally, much of this early finance was attracted when there was little, if any, evidence that the new techniques would be successful.

For these reasons, Chapter three investigated in some detail the reasons why venture capital was made available to fund NBFs. The main finding was that this owed little to any realisation on the part of financiers of the technological significance or merits of recombinant DNA and related procedures. Rather, much of this funding can be accounted for by a biotechnology investment 'hype' at that time. This was caused by interest in biotechnology being stimulated, indeed over-stimulated, firstly by a debate over the safety of recombinant DNA techniques and, second, through interest shown in the putative anti-viral agent, interferon. In other words, much of this early investment owed less to 'rational' decision making or the technological literacy of the venture capitalists involved, and more to 'follow-my-leader' investment behaviour.

12.2.2 Impediments to following the American strategy in Britain.

Notwithstanding the largely insubstantial basis for much of this early investment its effect, as previously indicated, was to put the US at the forefront of exploiting biotechnology. The election of the Conservative administration in Britain in 1979 put in place a Government committed to the private sector, market led development of industry, including new technologies such as biotechnology. It also sought to actively encourage entrepreneurship and small firm formation, and venture capital as a 'pump primer' for industrial regeneration and technology transfer. Not surprisingly, Britain has come to be one of the most active countries in seeking to emulate the American example of small firm development of new technology.

Several barriers to the success of such a strategy in Britain were identified in this study. Many of them are cultural - such as scientific attitudes to industry and commerce, industrial attitudes to new technology, financial attitudes to investment, the acceptability of entrepreneurship and wealth creation - and can be overcome, albeit with difficulty. However, one major impediment does remain. It is that the US has the world's largest market for biotechnology and biotechnology-related products. In contrast, the current size of the UK market is too small to support many of the potentially big products of biotechnology. Allowing the market to dictate which products are supported in Britain will, therefore, lead to the failure to support what could be a substantial number of British developments in biotechnology. To this extent, the market led development philosophy is an incomplete answer to the development of biotechnology in Britain, and will not solve the long standing technology transfer problem.

In passing, it seem relevant to add a coda to the Brookfield Instruments proposal used in this study. This proposal sought to manufacture a DNA sequencer, and was based on an actual case, that of a sequencer developed at the University of Manchester Institute of Science and Technology (UMIST). In the real case, no industrial sponsor could be identified in Britain who was prepared to take this on. The team who had developed the instrument were unwilling to manufacture it themselves. In contrast, as of December 1987 both US and European instrument manufacturers had shown considerable interest in the development of this and related equipment produced by the UMIST team (anon., 1987).

12.2.3 Determinants of venture capital investment.

The literature review also identified another impediment to the technology transfer process. This was that venture capitalists do not, contrary to popular opinion, invest in technology. Neither do they invest in the strategic development of industries. They may invest in companies which are active in the exploitation of high technology, but this is not the major determinant of their choice. Instead, venture capitalists invest in people and businesses. Again, if venture capital as it exists is perceived as an answer to the technology transfer process in Britain, it is either

failing, or is unable, to address the problem of the uptake of new technology by industry.

In summary, the impression gained in the course of this study is that venture capital-backed small firms are a useful adjunct to the development of biotechnology in Britain. They should not, however, be seen as the answer to Britain's seemingly perennial problem, that of being a nation that is good at invention but poor at innovation. In the absence of large established firm interest in the new technology, there is little evidence that venture capital is capable of supporting new technology, unless it can be demonstrated to exist within a framework which virtually guarantees success. This implies the presence of a suitable management team, the existence of a viable, or potentially viable, company and a market of demonstrably adequate size. Given the newness of much of biotechnology, and the difficulty of identifying market opportunities, coupled with impediments to small firm success mentioned previously, such an environment is extremely difficult to provide. Therefore, it is concluded that the development of biotechnology should more properly be carried out in a coordinated fashion, as a partnership between Government, industry, the City and academia, using the Japanese or French example as a role model, rather than adopting the American laissez faire approach, which is currently in vogue in the UK.

12.3 Findings of the Field Investigation of Venture Capital Project Evaluation Procedures and Attitudes to Biotechnology as an Investment Opportunity.

12.3.1 The nature of the evaluation procedure.

The findings of the investigation into venture capitalist investment evaluation procedures (Chapter eight) confirmed the view that venture capitalists invest in people, not products and businesses, not industries. The procedures adopted and the emphasis placed on particular items of information contained within business proposals appear to be consistent with findings presented in other, wholly US-based studies. The one difference noted between this and previous studies is the emphasis placed on

market size, reflecting the smaller size of the UK market compared to its American counterpart.

Another feature of the evaluation procedure not previously known to the author was the extent of the existence of bias in the evaluation of business propositions. This was found to relate to the venture capitalists' past experiences and the ethos of the venture capital firm within which they operate. It was indicated that bias dictated the way in which an individual approached an evaluation. For example, bias determined whether an individual would look primarily at the market, product or financial information contained within a proposal in formulating the initial accept/reject decision. This bias was incorporated into the formulation of the venture capitalists' heuristics, described below in section 12.3.2

The view that technology is not a key determinant of the evaluation decision was confirmed by these interviews. Amongst other things these showed that, with few exceptions, venture capitalists are not over-rigorous in their evaluation of the technology in the early stages of the evaluation process. Furthermore, even if a product was identified as being worthy of support, few were prepared to assist the investee by actively searching for management personnel who could make the project viable. This supports the view, put forward in section 12.2 above, that projects with commercial potential will continue to be lost by the UK for lack of a suitable mechanism to ensure the uptake and sustained support of new technology.

On the question of investing in biotechnology, the main risk factors identified were the long lead times for many projects and, related to this, the legislative and regulatory requirements for many of the products. The conservatism of end-users was also remarked upon. The newness and unfamiliarity of the technology was acknowledged but not seen as a major problem, since this was identified as a common feature of all high technology projects.

12.3.2 Evaluation of the business proposals.

The bulk of the data analysis was directed towards the evaluation of the two business proposals used in this study, Brookfield Instruments Ltd. (BIL) and Tissue Reproductions Inc. (TRI), described in Chapters nine, ten and eleven.

It was indicated that, in the main, the time taken to evaluate the proposals was representative of the time which would usually be allocated to the evaluation of an investment proposition. The interviews themselves, particularly the decision taken to allow the participants to describe what they felt was important in reaching their overall decisions, seemed reasonably successful. Reasonably, because the variability of the individual assessments made their analysis more problematic. That said, any attempt to guide the participants' evaluations would have lost the subtlety of the individual evaluations, which were abundantly demonstrated here. In any case, it will be recalled that the objective of these interviews was to discover what the participants themselves considered to be the determinants of their evaluation decision.

It could be possible, in the light of this, that some of the interviewees over-evaluated the proposals, that is, that they identified more items of information than they would ordinarily do. In any future study which uses this approach, consideration might be given to asking interviewees to describe their evaluations at interview, at first sight of the proposals.

In general terms, it was indicated that the proposals were similar in format to others received, and about average in terms of their information content. The single most common complaint in respect of their presentation related to details on the financial information contained in each. This overall impression matches that reported by Cope Pence of US venture capitalists responses to TRI (Cope Pence, 1982:51).

As stated above, the proposals elicited a wide variety of responses, in terms of identifying items of information deemed relevant to individual evaluations. Two main methods of data analysis were applied. The first was a content analysis which

sought to determine the frequency with which statements were made on items of information and whether they were perceived favourably or otherwise. The second, a statistical investigation based upon the content analysis, sought to find relationships between items of information and the overall evaluation of the proposals as investment opportunities. The aim in both cases was to identify key determinants of the evaluation decision.

The content analysis showed that, for the most part, both plans were assessed fairly critically as potential investees. The stage of company development and geographic location in particular held sway against a favourable evaluation for TRI. Disappointingly, this study was unable to identify precisely what the key determinants of the decisions were, in anything other than a limited sense. This included, for example, the rejection of proposals based on deal screening criteria. However, the study was unable to determine beyond these pre-determined criteria why a proposal was evaluated favourably or otherwise. This was because decisions frequently appeared to depend on the same information (for example, information on management) itself being evaluated favourably or otherwise according to the individuals involved. Coupled with the fact that decisions could be based on either one set of information alone, or on the interaction of a number of sets of information, the decision became too complex to be amenable to the analytical frameworks devised here.

Two main conclusions were drawn from this. The first related to the failure of statistical and other analytical frameworks applied to convey the complexity of the evaluation decision. Indeed, attempts to construct a scoresheet for the statistical analysis showed that these shortcomings are severe. It was concluded, therefore, that scoresheets and statistical approaches do not really convey what the venture capitalist actually evaluates in reaching an investment decision. Rather, scoresheets reflect what the investigator thinks the venture capitalist should find of interest. The second main conclusion was that the evaluator has to be taken into account in order to understand why certain items of information are selected for evaluation and why certain decisions are reached. From this, the idea developed of an 'holistic' approach to understanding the evaluation decision.

Chapter eleven sought to develop this holistic approach, by formulating an heuristic - the background, experiences and preferences which, in this case, enable a person to be a venture capitalist - for three of the individuals involved and applying this to their evaluation of the proposals. Unfortunately, because of time constraints and the fact that too little information was available to construct adequate descriptions of these heuristics, the model proposed was of limited success in explaining the evaluation decision. Nevertheless, it was concluded that an understanding of how and why decisions are made must be approached in this way.

As a general point, one of the biggest problems in this analysis was taking into account the effects of investigator bias. Indeed, it can only be acknowledged that unknown investigator bias exists in the results presented here. Given the nature of the analysis attempted, this would tend to argue the case for group rather than individual research. However, even using this approach bias may only be reduced, and not eliminated entirely.

Chapter ten looked at the evaluation of the two proposals using a predetermined scoresheet, filled in by the interviewees. This indicated that market and financial variables are associated quite strongly with the overall evaluation decision. The product variable is less strongly associated and the management variable shows no association. Notwithstanding the critical comments made on the use of questionnaires above, these results are interesting and contradict the notion that management information is the key determinant of the evaluation decision. However, management will be assessed on a face-to-face meeting, rather than from a C.V., which provides an explanation of why this result was obtained.

Using these scoresheets, a comparison of the evaluation of the TRI business proposal by UK and US venture capitalists was possible. This showed that UK venture capitalists evaluated this proposal less favourably than their US counterparts, both in terms of the overall evaluation decision and the evaluation of items of information contained within the proposal. In the case of the former, the relatively poorer UK evaluation may be accounted for by deal screening criteria, notably the geographic location of the

enterprise. The latter at first sight appears more revealing since it indicates a greater degree of caution on the part of UK investors. However, because the two evaluations were separated by a considerable time gap, this result should be interpreted with some caution. One thing which should be considered for future research is to prepare a proposal which would be acceptable to both UK and US investors, and compare their evaluations.

12.3.3 Use of hypothetical business proposals as a research tool.

Using hypothetical business proposals has both advantages and disadvantages. Although it was stated that those used in this study were comparable to real life cases, it was apparent from remarks made at the interviews that they had drawbacks associated solely with being hypothetical propositions.

The proposals were useful in that a number of participants indicated that they provided a novel alternative to more usual interview or questionnaire-based approaches to understanding investment decision making. The plans were also useful for eliciting responses from the interviewees. Because the proposals were the same in each evaluation, the differences in individual styles of evaluation were readily apparent. Against this, because the comments made were specific to the plan, extending the results found here to the more general case is contentious. For example, had the financial information been of an acceptable format - which was true of neither of the proposals used here - the comments made would probably indicate that the financial information is less important than appeared to be the case in this study.

12.4 Recommendations arising from this research.

Two major problems face the researcher contemplating a study of venture capital investment in Britain. The first of these is the relatively small size of the industry. The second is one of gaining access to venture capitalists, especially when sensitive decision making is involved. That said, despite the time commitment involved, the venture capitalists who took part in this present study were extremely helpful.

The major recommendation for further research is based on the main finding of this research, that an understanding of venture capitalist investment decision making can only be gained by examining in some detail the background and experience of venture capitalists. It is the view of the author that, as a research field, the area of venture capital investment lacks an adequate qualitative base on which to build, what is commonly perceived to be, a more substantive quantitative understanding of the evaluation decision process.

It is recognised that a behavioural approach such as this, given the small population available for study, will pose considerable difficulties for future researchers. For this reason, it may be fruitful as a first step to draw parallels between venture capital decision making and decision making under equally uncertain conditions. A body of literature does exist on this subject (see, for example, Kahney, 1986; Kahnerman et al, 1982) which may provide starting points for future research.

An alternative approach may be to study investment decisions immediately prior to, or immediately after, funds having been committed by the venture capitalist to a particular investment. If a sufficient number of such cases can be identified, it may be possible to understand more fully the nature of the evaluation decision. Although this may incorporate some post hoc rationalisation of the decision, it would be of interest to see precisely how uncertainty is reduced to risk through the evaluation procedure.

Finally, there now exists in Britain a large number of people who have received venture capital funding. Their experiences in gaining the backing of venture capitalists should be invaluable in building up a picture of the venture capital investment decision process.

12.4.1 Lessons for entrepreneurs and venture capitalists.

It was hoped that some set of guidelines for entrepreneurs who might be contemplating the preparation of a business proposal would result from this research. That any specific recommendations

did not emerge owes much, again, to the diversity of preferences expressed by the participants. Venture capitalists vary in the amount of information they wish to see in a proposal, the emphasis they place on any particular item(s) of information and the extent to which their evaluation decision is influenced by the perception of these item(s). With this in mind, the following general comments may be made.

Entrepreneurs should aim for brevity and economy of presentation for at least two reasons. First, because of the number of proposals received, a proposition which is easy to review will be looked on more favourably. Quantity is unlikely to be perceived as quality. Second, given a group of, say, five venture capitalists, it is unlikely that an entrepreneur will be able to prepare a proposal which fully satisfies the preferences of all five. It may be easier to provide information as requested, or indicate that it is available, rather than attempt to anticipate precisely what will be required and, as a result, prepare a fully comprehensive document which will not be read. However, an important general point did emerge from the evaluation of the two proposals in this study. In terms of their presentation, probably the most frequently cited observation was the inadequacy of the summaries provided. The need for a concise document with a punchy, up-beat summary cannot be overstated.

There are a number of excellent guides to preparing business proposals, two of which were used in this study Arthur Young, 1984; Ormerod, 1985). Many accountancy firms have prepared such guides, from whom they may be readily obtained. However, some of the strongest opinions expressed in this study were those concerning the role of intermediaries, mainly accountants, in the preparation of business proposals. Whilst the use of intermediaries for advice in the preparation of proposals is acceptable, and may be welcomed, proposals prepared by intermediaries are almost universally not. Venture capitalists wish to see a 'warts and all' document, prepared by the management team, a proposal which will sell the business. Indeed it could be argued that, given the propensity of venture capitalists to invest in people, if the management team cannot successfully sell the

idea on offer in the business proposal, how can they hope to sell the product in the marketplace?

One final point is of relevance here, and it probably causes more misunderstandings than any other in the relationship between entrepreneurs and venture capitalists, or any other source of finance which may be approached. It is that the entrepreneur is seeking to develop a product or idea. Consequently, the point of focus for the entrepreneur approaching a financier will be the product. Failure of the business to obtain finance will be perceived as a failure on the part of the financier to recognise the potential and merits of the product.

The problem is, as has been shown in this and other studies, that venture capitalists are not investing in the product or idea. They are not seeking to develop the product. They are investing in order to gain the maximum possible return on their capital. To do this, they are investing in the entrepreneurial talent of the management team which, for them, is the key factor in determining whether the investment will be a success.

So, whilst an entrepreneur may approach a venture capitalist for backing for a new product or idea, this can be seen to be the wrong approach. Instead, the emphasis should be on promoting the business. For many entrepreneurs, especially those seeking backing for the first time, this may seem the wrong orientation. But this reflects no more than the reality that, in negotiating a finance package, the negotiation is carried out on the financier's terms. Presumably, entrepreneurs who have been successful in obtaining finance have recognised this reality and have come to terms with it.

Indeed, the fact that in the final analysis venture capitalists dictate the terms on which finance is made available to new firms means that it is difficult to present any findings which may have a bearing on their investment behaviour. It is clear that, in any case, they will invest their funds on criteria which are consistent with the investment philosophy of the individual venture capital firm. Therefore, appeals that they should attempt to bridge the communication gap by becoming technologically

conversant with their investees, or that they should take greater risks in their investment, or that they should be more hands-on in their relationship with their investee companies (to overcome the shortage of suitable managerial talent which may prevent a promising technology from being developed) are unlikely to be heeded. Any perceived shortfalls in the role venture capitalists play in supporting new technology in Britain are more a reflection that, for all their 'hi tech' associations, venture capitalists are financiers, not agents of technology transfer.

Investors in Industry apart, the bulk of the British venture capital industry is still less than ten years old. Unlike its American role model, it has yet to establish a solid track record of success and credibility. One impression gained in the course of this research is that a significant proportion of the venture capital industry are not venture capitalists in the sense of adding value to their investee companies. In many instances, the term venture capital appears to be more of a marketing exercise, a sobriquet which enables a firm to be associated with what has come to be seen as a fashionable area of business finance. This may account for many instances where the loss of an investment is seen as something to be avoided at all costs, rather than accepted as part and parcel of operating in this high risk area.

In fairness, this is probably true of many venture capital firms operating in America too. It could be argued that at least funding is being made available to small firms on a much greater scale than has been the case for many years. Nevertheless, venture capital in Britain can only benefit from the experience it gains in new business finance. As it does so, hopefully it will appreciate even more the difficulties faced by entrepreneurs starting out in business for the first time. In this way, the communication barrier between the financier and the entrepreneur may begin to be broken down. Perhaps with time, a more proactive style will emerge, with investees being actively supported by venture capitalists who see the merits and potential of the technology involved, investors who are willing to construct a company which will allow important new technologies to develop. If this should come to pass, then the British venture capital industry will deserve its 'hi tech' association.

One final comment will serve to sum up this thesis. Let us suppose that somewhere in Britain today there is a laboratory product which represents a major technological breakthrough in its field. The point of this thesis has been; does any mechanism currently exist in the UK which will identify this product and guarantee to carry its development through to a successful conclusion? Based on the evidence obtained in the course of this work, the answer to this question is no. Whether any mechanism can guarantee such success is, of course, highly unlikely. However, to assume that venture capital is an agent of technology transfer, and will provide this answer, is erroneous.

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APPENDICES

APPENDIX ONE

AN ANALYSIS OF THE UK VENTURE CAPITAL INDUSTRY BASED ON PUBLISHED SOURCES OF DATA

Contents. Page.

List of Tables.

A.1.1 Introduction.

This appendix presents an overview of the investment preferences of British venture capitalists as expressed in a selection of guides to sources of venture capital. It supplements material presented earlier in Chapters four and five of this thesis.

The following guides were used in the preparation of this appendix:

Financial Times, 'Major Sources of Venture Capital in the UK, 1984' (Financial Times, 1984).

Financial Times, 'Major Sources of Venture Capital in the UK, 1985' (Financial Times, 1985).

Financial Times, 'Major Sources of Venture Capital in the UK, 1986' (Financial Times, 1986).

Stoy Hayward, 'Sources of Venture and Development Capital in the United Kingdom 1986' (Stoy Hayward, 1986).

Venture Capital Report, 'Guide to Venture Capital in the UK', 3rd edn. (Cary, 1987).

Venture Economics, 'Guide to European Venture Capital Sources, 1985' (Pratt and Lloyd, 1985).

Table A.1.1 below displays the number of firms listed in each source of information.

Table A.1.1 Number of venture capital funds listed in the guides to venture capital sources used in compiling this appendix.

Source	Number of funds listed
Financial Times, 1984	123
Financial Times, 1985	139
Financial Times, 1986	147
Stoy Hayward	129*
Venture Economics	95
Venture Capital Report	129

*Also listed separately are 29 business expansion scheme (BES) funds. Of these, 16 are administered as part of a venture capital fund, whilst 13 are BES funds alone, making the total number of funds included in the Stoy Hayward guide 142.

A number of classifications exist for the types of venture capital firms operating in Britain. The Venture Economics guide provides 38 such descriptions. These are re-classified in table A.1.2 (below) according to four broad groupings derived from Lorenz (1985).

Table A.1.2 Classification of UK venture capital funds.

Classification	Number of funds	Total
1. Clearing bank captive funds.		
(i) Domestic	9	
(ii) Foreign	2	11
2. Investment institution-backed funds.		
(i) Captive institutional funds	19	
(ii) Independent venture capital funds;		
(a) semi-captive	21	
(b) wholly independent	32	72
3. Corporate and other private sector funds.		
(i) Corporate venture capital	5	
(ii) Private foundations	2	
(iii) Universities	1	8
4. Semi-state/local government funds.	4	4
	Total	95

Source: Venture Economics (Pratt and Lloyd, 1985).

The Venture Capital Report guide provides an alternative, complementary classification of the 129 funds it lists as providers of, or intermediaries connected with the provision of, venture capital in the UK. They are classified under the following six headings:

1. Specialist venture capital companies;
2. Business expansion scheme funds;
3. Banks;
4. Organisations with Government funds;
5. Fund managers; and
6. Others.

The date of formation of the funds classified under these headings, which were active as of June 1986, are shown in table A.1.3 overleaf.

Table A.1.3 Date of formation of UK venture capital funds.

Year of formation	Type of fund 1	2	3	4	5	6	Total
pre-1970	1		4	3	3	1	12
1971-75	1		2		1		4
1976	2			2		2	6
1977	2						2
1978	1		1		1		3
1979	1		2				3
1980	4		3		4	2	13
1981	8	2	4		3		17
1982	3	1	1	1	1	1	8
1983	4	8	4	1		1	18
1984	7	6	1	1	1	1	17
1985	7	1	2			1	11
1986	4			1		2	7
No date given	1	1		1		5	8
	46	19	24	10	14	16	129

Source: Venture Capital Report (Cary, 1987).

Tables A.1.2 and A.1.3 show that more than three quarters of all venture capital firms have been formed since 1980, and that privately owned financial institutions have been the major force behind this growth of interest in small firm financing. However, some care must be taken in interpreting the significance of these findings. Apart from Government-backed organisations (such as the Industrial And Commercial Finance Corporation (ICFC)), most providers listed as being active prior to 1980 in table A.1.3 in reality only became venture capital lenders subsequently. These include merchant and clearing banks who, over the last decade, have established venture capital divisions as subsidiaries to their main stream operations in response to the lead set by independent venture capital firms. Also, as was mentioned in Chapter four, although the private sector is growing in importance, ICFC remain the largest single provider of venture capital funding in the UK, accounting for over 50% of venture capital disbursement.

A.1.2 Investment preferences of UK venture capital firms.

Chapter five described, in general terms, the importance of deal screening criteria in the project evaluation process. The tables contained in this section present supplementary information on these criteria, specific for the investment preferences of UK venture capitalists.

Table A.1.4 on the next page displays the different industry sectors which venture capitalists, listed in the Venture Economics guide, expressed an interest in. Table A.1.5, which follows, indicates the number of sectors in which individual firms were

interested. Finally, table A.1.6 shows investments made by industry sector by venture capital firms in 1983 and 1984.

Table A.1.4 Industry sector investment preferences.

Industry sector	Number of companies
No sector preference*	27
Management buy-outs in any sector	1
*Of these, property (twice), energy and natural resources (once) and agriculture/forestry/fisheries (once) were mentioned as sectors where investments would not be made.	
Communications	63
Computer related	62
Electronic components and instrumentation	66
Electronics	1
Defence electronics	1
Equipment and machinery	54
Industrial automation/Process control/Robotics	53
Energy/Natural resources	35
Environmental related	1
Metals/Minerals	1
Medical/Health related	60
Genetic engineering	38
Biotechnology	3
Agriculture/Forestry/Fisheries	25
Agriculture	2
Chemicals/Plastics	49
Distribution systems	39
Finance and insurance	22
Franchise businesses	19
Consumer products	50
Other consumer related	37
Hotels/Restaurants/Leisure	36
Retail	37
Food processing	1
Publishing	37
Film/Video	1
Property	7
Construction	1
Construction/Building materials	1
Civil engineering	1
Motor car manufacture (specialist sector)	1

Source: Venture Economics (Pratt and Lloyd, 1985)

Table A.1.5 Number of sector preferences listed by companies in the Venture Economics guide.

Number of sectors	Number of companies
4	3
6	5
7	7
8	6
9	7
10	3
11	2
12	2
13	11
14	3
15	3
16	5
17	5
18	5
21	1
All sectors considered	27
	95

Source: Venture Economics (Pratt and Lloyd, 1985)

Table A.1.6 Investments by industry sector.

Sector	% of companies financed	
	1983	1984
Consumer related	21	19
Computer related	25	16
Electronics related	13	11
Medical/genetics	6	8
Industrial products	7	7
Communications	6	6
Transportation	3	5
Energy/mining	-	5
Construction	2	4
Other manufacturing	4	6
Other services	13	13

Source: Venture Economics, published in Financial Times (1985).

The preference for investment in businesses whose activities are centred on semiconductors, namely computer and electronics-related businesses, is clearly demonstrated in the above tables. It is also of interest to note that, although consumer-related businesses rated only fairly highly in terms of preferences (table A.1.4), in terms of actual investments made (table A.1.6) they were second only to those made in semiconductor-related businesses. In contrast, although medical/health-related businesses ranked highly in terms of preference (these are taken

to include biotechnology-related businesses such as monoclonal antibody-based diagnostics), relatively few investments were actually made in this sector. Finally, table A.1.5 indicates that there only a few sector specific funds operate in the UK, with most venture capital firms preferring to invest in a number of different sectors.

Table A.1.7 (below) shows the preferences of UK venture capital firms between 1984 and 1986 in terms of the stage of investee company development. Note that these are not actual investments made. That said, the table indicates a preference for development and management buy-out financings, with start-up, replacement and rescue financings being somewhat less popular.

Table A.1.7 Investment preferences by stage of investee company development, 1984-1986.

1984	Finance available?					
Stage of investee	Yes		Possible		No	
	No.	%	No.	%	No.	%
Start-up	79	64.2	26	21.1	18	14.6
Development	112	91.9	5	4.1	6	4.9
Replacement	65	52.8	34	27.6	24	19.5
MBO	107	87.0	9	7.3	7	5.7
Rescue	42	34.1	46	37.4	35	28.4

1985	Finance available?					
Stage of investee	Yes		Possible		No	
	No.	%	No.	%	No.	%
Start-up	93	66.9	26	18.7	20	14.4
Development	134	96.4	3	2.2	2	1.4
Replacement	79	56.8	33	23.7	27	19.4
MBO	123	88.5	9	6.5	7	5.0
Rescue	52	37.4	47	33.8	40	28.8

1986	Finance available?					
Stage of investee	Yes		Possible		No	
	No.	%	No.	%	No.	%
Start-up	92	62.2	33	22.3	23	15.5
Development	141	95.3	4	2.7	3	2.0
Replacement	87	58.8	33	22.3	28	18.9
MBO	134	90.5	9	6.1	5	3.4
Rescue	53	35.8	51	34.5	44	29.7

Source: Financial Times, 1984; 1985; 1986.

The next two tables indicate the degree of hands-on involvement sought by UK venture capitalists in their investee companies. Table A.1.8 describes the preferred relationship with portfolio

companies expressed by venture capitalists in the Venture Economics guide. 81% of firms take a seat on the board of investee companies, with 66% indicating that they offer some kind of active management advice. In contrast, it appears that some 13% merely monitor their investments. Table A.1.9, based on the Financial Times guides, indicates that the preference for a seat on the board of investee companies is considerably higher than is indicated in the Venture Economics guide (table A.1.8), with around 95% of venture capital firms expressing such a preference.

Table A.1.8 Type of relationship with portfolio company.

Relationship	Number of funds
Active management advice	63
Financial advice	61
Seat on board	77
Monitoring only	12
Fees charged	48
Reserve right to appoint non-executive director	1
Active management/technical/ marketing/financial advice	1
Not stated	6

Source: Venture Economics (Pratt and Lloyd, 1985).

Table A.1.9 Preference for seat on board of investee companies.

	Seat on board					
	1984		1985		1986	
	No.	%	No.	%	No.	%
Yes	60	48.8	81	58.3	75	50.7
Possible	1	0.8	2	1.4	3	2.0
No	9	7.3	6	4.3	8	5.4
Usual	21	17.1	26	18.7	37	25.0
As appropriate	32	26.0	24	17.3	25	16.9
		100.0		100.0		100.0

Source: Financial Times, 1984; 1985; 1986.

The remaining tables in this section concern the financing preferences of UK venture capital firms. Table A.1.10 on the next page shows, not surprisingly, the overwhelming preference for equity investment. However, this table also shows that over one third of respondents made pure loan investments too. Taking into account those who made loans available with equity investment, over 60% of the firms in the Financial Times guides made both loan and equity investments. This mixture of debt and equity financing may owe much to many venture funds being subsidiaries of 'traditional' financial institutions, such as the clearing banks.

Table A.1.10 Type of finance provided.

	1984				1985				1986			
	Equity		Loan		Equity		Loan		Equity		Loan	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	117	95.1	53	43.1	138	99.3	48	34.5	145	98.0	52	35.1
Possible	-	-	3	2.4	-	-	4	2.9	1	0.7	3	2.0
No	6	4.9	36	29.3	1	0.7	39	28.1	2	1.4	34	23.0
With equity			31	25.2			48	34.5			59	39.9

Table A.1.11 (below) displays the preferred term of funding prior to investment realisation of venture firms in the Financial Times guides. This table appears to indicate a preference for short- to medium-term investments, with relatively few venture capital firms seeking long-term investment opportunities.

Table A.1.11 Term of funding for UK venture capitalists, 1984-1986.

Term of funding (years)	Number of funds.		
	1984	1985	1986
2-7			1
3-4			1
3-5	2	4	6
3-7	3	3	6
3-8	1		
3-10	1	1	1
4-7			1
Up to 5	20	14	13
5+	1	4	1
5-7	7	11	9
5-8	1	1	1
5-10	2	3	4
5-20	1		
Up to 7	2		
7-10			1
Up to 8			1
Up to 10	3	5	5
10-15			1
To 1993	1	1	1
Medium (3-6)		1	1
Medium	13	23	23
Medium/long	10	8	11
Long/long-term	9	13	10
Flexible	33	30	30
Open	8	10	11
As appropriate	6	6	6
Mainly long-term		1	1
Loans 3-4	1		

Source: Financial Times 1984; 1985; 1986.

Tables A.1.12, A.1.13 and A.1.14 which follow display the minimum funding levels considered by venture capitalists in the three Financial Times guides. On the basis of the information presented in the the first two tables, venture capital firms would appear to be meeting the need for relatively small amounts of equity funding, that is, sums below £50,000, where a perceived funding gap exists. That such a gap is still perceived to exist indicates that this funding is not as available as entrepreneurs might wish. Table A.1.14 presents the average minimum funding level considered by UK venture capital firms.

Table A.1.12 Minimum funding levels considered by venture capital firms, 1984-1986.

Amount considered (£ '000s)	Number of firms 1984	1985	1986
Less than 5	22	16	14
5-20	10	7	8
23-50	32	46	45
60-90	2	3	2
100	27	33	26
125-150	5	7	7
200	10	13	16
250	9	9	19
300	4	3	1
Above 300	2	2	8

Source: Financial Times, 1984; 1985; 1986.

96 venture capital firms appear in all three Financial Times guides to venture capital sources. Table A.1.13 (below) compares how the minimum funding levels considered by these firms changed over this three year period.

Table A.1.13 Minimum funding levels considered by companies appearing in all three Financial Times 'Major Sources of Venture Capital in the UK', 1984-86.

Amount considered (£ '000s)	Number of firms 1984	1985	1986
Below 10	15	14	13
10-49	16	16	11
50-99	19	18	21
100-149	21	24	18
150-199	4	5	6
200-249	8	8	11
250 and above	13	11	16
	96	96	96

Source: Financial Times, 1984; 1985; 1986.

Table A.1.14 Mean funding levels considered by companies appearing in all three Financial Times 'Major Sources of Venture Capital in the UK', 1984-86.

The Financial Times Guides to Sources of Venture Capital include a 'minimum funding considered' category of 0. The meaning of this is unclear. Therefore, this table presents calculations of the mean funding levels provided with these 0 values excluded and included as indicated.

Similarly, because the figure of £ 1m. appears for 1986 only, the calculations for 1986 have (a) excluded and (b) included sums above £ 500K.

The minimum funding levels presented in the Stoy Hayward ('SH') guide have been included for comparison.

	(Excluding 0)			(Including 0)		
Year	Number of firms	Mean	S.D.	Number of firms	Mean	S.D.
1984	83	114.8	98.3	96	99.3	99.5
1985	85	112.4	98.0	96	99.5	98.9
1986(a)	87	122.6	102.3	96	132.0	162.9
(b)	89	142.3	164.8			
SH(a)	109	136.7	98.9			
(b)	111	161.3	216.8			

Finally, table A.1.15 on the next page presents the maximum funding levels considered by UK venture capital firms. This shows a slight tendency towards funding higher priced deals.

Table A.1.15 Maximum funding levels considered by companies appearing in all three Financial Times 'Major Sources of Venture Capital in the UK', 1984-86.

	Number of firms		
Amount considered (£ '000s)	1984	1985	1986
40	1	1	1
50	5	4	5
60	1	1	1
75	2	3	1
100	4	4	3
150	1	3	3
200	3	4	4
250	6	9	9
300	4	5	4
350	3	3	4
400	2	3	3

... continued

Table A.1.15 (continued)

450	1	1	1
500	17	17	11
600	1		1
700	1		
750	5	7	11
800			1
850		1	
1 000	22	22	17
1 500	4	6	10
2 000	5	5	5
2 500	2	2	4
3 000	4	6	8
4 000	1	1	1
5 000	4	4	5
7 000	1	1	1
9 000	1		
10 000	1	2	5
15 000	1	1	1
20 000			1
35 000			1
62 500			1
100 000	1		1
Open	18	23	24
	123	139	147

Source: Financial Times, 1984; 1985; 1986.

A.1.3 Summary.

The information contained in this appendix is based on venture capitalists' investment preferences, as expressed in the guides to venture capital sources used in its preparation. As such, it may be taken only as a reflection of their actual investment activities. With this in mind, the following general points may be made.

The emergence of venture capital in Britain in the 1980s has led to a considerable expansion in the provision of equity funding for small firms. That this funding has been made available reflects a re-appraisal, by the large financial institutions, of the investment opportunities offered by small firms. These institutions have made finance available either through extensions of their core business operations, or through their investment in newly created independent venture capital firms. Private individuals have also made a substantial contribution via the Business Expansion Scheme. Nevertheless, with around 50% of funding still coming from Investors in Industry (formerly ICFC), the amount of funding made available through the newly formed funds should be kept in proportion.

The role of existing financial instituitons in establishing the modern venture capital industry is reflected in a number of ways.

Venture capital firms have a propensity to invest in development financings and management buy-outs. Most may be considered to be generalist investors although, again, there is a preference for investment in a relatively narrow range of sectors, mainly those connected with semiconductors and consumer-related activities. There is evidently some degree of proactive investment management, however, the degree of active involvement is difficult to gauge. Finally, there is evidence of a preference for short- to medium-term lending.

Table A.1.16 (overleaf) provides a summary of UK venture capitalists' investment activity based on actual, rather than preferred, investment behaviour. It is of interest to note that Government-backed funds invest in a greater proportion of the investment propositions they receive and, of these, a greater proportion are start-ups than for other venture capital sources.

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Pratt, S.E. and Lloyd, S.E., 1985, Guide to European Venture Capital Sources, Unwin Brothers Ltd.

Stoy Hayward, 1986, Sources of Venture and Development Capital in the UK, Stoy Hayward.

Table A.1.16 Summary of UK venture capitalist investment activity.

	Specialist venture capital companies	BES funds	Banks	Government-backed funds	Fund managers	Others
1. Number of companies	46	19	24	10	14	16
2. Average investment made (£ '000s)						
(a) smallest	25	43	100	50	125	40
(b) largest	1,200	450	900	150	5,800	1,500
(c) average	397 (n=44)	196 (n=18)	397 (n=23)	88 (n=4)	395* (n=11)	327* (n=7)
3. Stage of investment undertaken (%)						
(a) start-up	34.0 (n=41)	30.2 (n=17)	14.8 (n=16)	40.6 (n=5)	17.1 (n=8)	21.3 (n=6)
(b) development	45.6 (n=43)	62.7 (n=17)	52.4 (n=22)	48.2 (n=5)	53.2 (n=11)	57.6 (n=7)
(c) buy-out	24.8 (n=31)	14.4 (n=8)	38.3 (n=20)	12.8 (n=4)	42.5 (n=11)	24.1 (n=7)
4. Investment strike-rate (%)						
Number of proposals:						
(a) reviewed/ received	23.0 (n=41)	21.1 (n=16)	24.1 (n=14)	38.5 (n=4)	19.8 (n=9)	22.9 (n=8)
(b) invested in/ reviewed	17.2 (n=41)	16.7 (n=16)	14.1 (n=15)	26.1 (n=4)	24.1 (n=10)	35.9 (n=7)
(c) invested in/ received	3.2 (n=41)	2.7 (n=16)	2.6 (n=16)	9.9 (n=4)	4.2 (n=9)	4.4 (n=7)

*excluding maximum figure cited in (b).

Source: Venture Capital Report (Cary, 1987).

APPENDIX TWO

QUESTIONNAIRES AND SCORESHEETS USED IN THIS STUDY

Contents. Page.

A.2.1 Interview schedule to investigate venture capitalist investment activity in biotechnology.

A.2.1.1 Attitudes to biotechnology investment.

GENERAL INTRODUCTION

1. Management Accounting, June 1984;

   "(Biotechnology) is the least understood of the new technologies and also one in which marketable results are most elusive".

   Why put money into high technology in general, and biotechnology in particular?

2. Does biotechnology have any features that distinguish it from other categories of investments?

3. Biotechnology projects typically have long development times. How does this affect your assessment of biotechnology projects, and what steps would tend to make these less liquid investments more attractive?

4. What is the role of venture capital in the development of biotechnology, how does it influence this development, and what can be done to improve the exploitation of biotechnology on the UK?

A.2.1.2 Evaluation staff - backgrounds and experience.

A. Project Evaluation - Staff

1. How many staff are involved in project assessment and evaluation?

2. What background or qualifications are looked for in staff working in this area?

3. Do any of your staff have experience or expertise (academic, industrial, managerial or otherwise) in the high technology areas in which you invest?

4. Do any of your staff have experience or expertise in biotechnology or biotechnology related areas?

5. Did they review this plan?

A.2.1.3 General information on the types of proposals received and background to the evaluation procedure.

B. Project Evaluation - Background on proposals received

1. How many entrepreneurs contact you with project ideas or business plans in the course of a year?

2. How many of these contacts are rejected immediately because they are outside of the industrial or commercial sectors in which you have an interest?

3. How many of the proposals which fall within the industrial sectors in which you specialise actually go on to receive funding?

4. What proportion of these contacts are biotechnology or biotechnology-related proposals? How has this proportion altered in recent years?

5. Could you comment on the quality of the business proposals you receive? (By this I mean both the quality of the proposals as potential businesses, and the quality of the proposals as written documents.)

... continued

Background on proposals received (continued)

6. Could you comment on the reasons why a project may be rejected? (For example, is the form of the business proposal important, or is it because the management team is too inexperienced, or the profit forecasts not acceptable? Do you find that one of these factors, or some other factor, is the dominant reason for proposal rejection?)

7. What sort of time scales are we talking about between initial contact by the entrepreneur and a proposal actually receiving funding?

8. How does the amount of finance sought affect the way you review a proposal?

A.2.1.4 Details of the evaluation procedure.

C. Project Evaluation - Details of procedure

1. Could you describe in general terms the evaluation procedure used here, from the time a proposal is received until it is either rejected or receives funding.?

2. Does this procedure incorporate some form of standardised format, for example checklists incorporating a scoring system?

3. (If not) is this because such a system has been tried and found ineffective, or has it been considered impractical due to the diversity of the proposals you receive, or has it never been considered because such a system is irrelevant for your needs?

4. How many people are involved in the assessment and evaluation of a particular proposal?

5. Is all of the evaluation undertaken 'in-house', and if not, at what stage and for what purpose is outside advice sought, and what strengths do exist 'in-house'?

6. How are these external sources of advice selected?

A.2.2 Cope Pence scoresheet. (Cope Pence, 1982:25-26.)

BUSINESS PLAN EVALUATION CHECKLIST.

1. VALUE TO THE WORLD Usefulness of the product, it's ability to meet a real need as opposed to a perceived need.	-2	-1	0	1	2
2. DEMAND GROWTH Degree to which the product is demanded in the market place, it's rate of demand growth.	-2	-1	0	1	2
3. AVAILABILITY OF SUBSTITUTES Degree to which substitutable products exist,degree to which these substitutes are in demand.	-2	-1	0	1	2
4. PRICE ELASTICITY The degree of demand change at varying product prices.	-2	-1	0	1	2
5. TECHNOLOGICAL CHARACTERISTICS Product durability, sophistication of technological components, products physical characteristics, production process, substitutability of production process and/or parts.	-2	-1	0	1	2
6. MARKETING AND ADVERTISING STRATEGIES Plans and commitments for getting the product to the marketplace, including financial commitment.	-2	-1	0	1	2
7. PRODUCT LIABILITY Degree of potential hazardousness to the user, cost of appropriate insurance.	-2	-1	0	1	2
8. GOVERNMENT REGULATIONS Degree to which the product and its products are subject to government inspection and regulation, time and costs associated with compliance.	-2	-1	0	1	2
9. RESEARCH AND DEVELOPMENT COMMITMENTS Amount of revenue as percentage of gross income allocated to R&D, relationship of R&D function to the overall business plan.	-2	-1	0	1	2
10. MARKET SIZE Size of the market in terms of number of participants and total potential income.	-2	-1	0	1	2

...continued

11. DISTRIBUTION SYSTEM Method by which the products leave the production system and are delivered to the marketplace.	-2	-1	0	1	2
12. MARGINS Appropriateness and adequacy of gross and net margins.	-2	-1	0	1	2
13. YEARS TO MATURITY Appropriateness and acceptability of expected number of years for the firm to reach maturity.	-2	-1	0	1	2
14. CAPITAL NEEDED Appropriateness and suitability of the capital requirements.	-2	-1	0	1	2
15. PERCENTAGE OF MARKET The actual and potential relative position in the marketplace.	-2	-1	0	1	2
16. EXIT POTENTIALS Future availability of satisfactory opportunities for obtaining liquidity, including the time horizon for attaining such opportunities.	-2	-1	0	1	2
17. MARKET BARRIERS The proprietariness of the product, its ability to succeed in the marketplace, amount of marketplace competition.	-2	-1	0	1	2
18. PROFIT AND LOSS EXPERIENCE Relevant profit and loss experience of the chief officer(s).	-2	-1	0	1	2
19. TECHNICAL KNOWLEDGE Relevant technical knowledge of the chief officer(s).	-2	-1	0	1	2
20. MANAGEMENT COMMITMENT Degree to which management is personally and financially committed to the new business.	-2	-1	0	1	2
21. MANAGEMENT TEAM EXPERIENCE General experience of each team member, appropriateness and relevance of the experience, overall team design in terms of experience.	-2	-1	0	1	2

A.2.3 Evaluation rating scoresheet.

EVALUATION RATING

Below is an evaluation scale* showing five possible responses to the TISSUE REPRODUCTIONS INC. business plan. Please indicate which is the most appropriate rating for your evaluation.

Proposal will not be considered.	1
Proposal would be worth a couple of telephone calls.	2
Proposal would be reviewed more carefully and telephone calls made.	3
Proposal would be actively pursued as a strong investment candidate.	4
Proposal would be likely to receive financing. (indicating that you are extremely enthusiastic about the project and, barring any major unforeseen circumstances, would endeavour to find some way of financing this deal).	5

*(Source; Cope Pence, 1982:34)

If your evaluation above is (1), is this because;

although the project is interesting in itself, it does not meet your portfolio or other requirements,	A
there are major inherent shortcomings in the project which make it an unattractive investment proposition,	B
a combination of both these factors,	C
some other reason(s).	D

How did this plan compare with other business proposals you receive? Was it:

POOR	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE	GOOD

A.2.4 Tyebjee and Bruno scoresheet. (Tyebjee and Bruno, 1984:38.)

		Poor	Adequate	Good	Excellent	Unsure
1)	[ ] Management skills.	1	2	3	4	?
2)	[ ] Marketing skills.	1	2	3	4	?
3)	[ ] Financial skills.	1	2	3	4	?
4)	[ ] Technical skills.	1	2	3	4	?
5)	[ ] References of entrepreneurs.	1	2	3	4	?
6)	[ ] Profit margins.	1	2	3	4	?
7)	[ ] Uniqueness of product.	1	2	3	4	?
8)	[ ] Patentability of product.	1	2	3	4	?
9)	[ ] Raw material availability.	1	2	3	4	?
10)	[ ] Production capabilities.	1	2	3	4	?
11)	[ ] Access to markets.	1	2	3	4	?
12)	[ ] Market need for product.	1	2	3	4	?
13)	[ ] Size of market.	1	2	3	4	?
14)	[ ] Growth potential of market.	1	2	3	4	?
15)	[ ] Freedom from regulation.	1	2	3	4	?
16)	[ ] Resistance to economic cycles.	1	2	3	4	?
17)	[ ] Protection from competitive entry.	1	2	3	4	?
18)	[ ] Hedge against current investments.	1	2	3	4	?
19)	[ ] Merger/Acquisition potential.	1	2	3	4	?
20)	[ ] Opportunities for exit.	1	2	3	4	?
21)	[ ] Tax benefits of venture.	1	2	3	4	?
22)	[ ] Protection against down-side risk.	1	2	3	4	?

References.

Cope Pence, C. (1982), How Venture Capitalists Make Investment Decisions, Ann Arbor, Michigan: UMI Research Press.

Tyebjee, T.T. and Bruno, A.V. (1984), Venture Capital Allocation Decisions and Their Performance, California: Santa Clara University, July. US Government Order No. PB85 - 181584.

APPENDIX THREE

PARTICIPANTS IN THIS STUDY

Contents

A.3.1 Venture Capital Firms participating in this study.

Abingworth Management Limited, London.
Advent Limited, London.
Barclays Development Capital Limited, London.
Baronsmead Associates Limited, London.
Biotechnology Investments Limited, London.
British Technology Group, London.
Charterhouse Japhet Venture Fund, London.
County Bank Limited, Birmingham.
Equity Capital for Industry Limited, London.
F.& C. Ventures Limited, London.
Hambros Advanced Technology Trust P.L.C., London.
Kleinwort Benson Development Capital Limited, London.
Larpent Newton & Company Limited, London.
MTI Managers Limited, Watford, Hertfordshire.
Murray Johnstone Limited, Glasgow.
Newmarket Venture Capital Limited, London.
Oakland Management Holdings, Hungerford, Berkshire.
Quester Capital Management Limited, London.
Schroder Ventures, London.
Scottish Development Agency, Glasgow.
Transatlantic Capital (Bio-Sciences) Limited, London.
Venture Founders Limited, Banbury, Oxfordshire.
Water Authorities Superannuation Fund, London.
Welsh Development Agency, Cardiff.

ASTON UNIVERSITY

Corporate Management Division.

Dear

Please find enclosed the two hypothetical business proposals I would like you to evaluate.

The Brookfield Instruments proposal is for a UK company which wishes to develop its existing business, an import sales and service operation supplying advanced instrumentation to British biotechnologists, into an export manufacturer of this type of equipment. The Tissue Reproductions plan, for a US company which wishes to commercialise a novel material for use in plastic surgery, is taken from 'How Venture Capitalists Make Investment Decisions' by Christine Cope Pence, UMI Research Press, 1982. The results of her study will be made available to you when we meet to discuss your evaluation of the plans.

The purpose of this study is to understand how Venture Capitalists decide whether to investigate a proposal beyond initial submission of the business plan by the entrepreneur. So, whilst primarily wishing to discuss your assessment of the proposals as potential investment opportunities, I am also interested in the evaluation procedures used at . I do of course recognise that the two plans may not meet your portfolio or other requirements. For the purposes of this study this study I would however be grateful if you could assess the plans both independently and in the context of these requirements.

On completion of the study, the results will be analysed and made available to you. Whilst no comments you may make will be attributed to you personally, I would ask that be identified as one of the participants in the study.

I will call your office next week to arrange a suitable time to discuss your evaluation, and look forward to meeting you then.

Yours sincerely,

Ian Lawrence.

Aston Triangle, Birmingham B4 7ET. Telephone 021-359 3611. Telex 336997 UNIAST G

APPENDIX FOUR

AN ANALYSIS OF THE FREQUENCY OF STATEMENTS MADE ON THE BROOKFIELD INSTRUMENTS LTD. AND TISSUE REPRODUCTIONS INC. BUSINESS PROPOSALS

Contents. Page.

Tables.

A.4.1 Introduction.

This appendix presents data showing the frequency with which identifiably separate statements were made on the BIL and TRI proposals.

A.4.2 The Total Number of Statements Made on Each Proposal.

Appendix 4.1, containing tables A.4.2.1 (BIL) and A.4.2.2 (TRI), shows the total number of statements made under each of the following headings;

1. Management,
2. Marketing,
3. Product,
4. Financials,
5. Competition,
6. Ownership of Technology,
7. Stage of Company Development,
8. Comments on Proposal,
9. Geographic Location of Enterprise (TRI only) and
10. Product Liability (TRI only).

The format for the presentation of this data is shown in the following example:

Venture capitalist	Management	
1	1	(a)
	3.7	(b)
	1.9	(c)
	2.3	(d)

where (a) = the number of statements made by venture capitalist 1 on management aspects of the proposal being evaluated;

(b) = the number of statements made on management aspects as a percentage of all the statements made by the individual venture capitalists on the proposal;

(c) = the number of statements made by venture capitalist 1 on management as a percentage of the total number of statements on management aspects made by all the participants (showing to what extent any individual is contributing to the number of statements made on any particular aspect of the proposal);

(d) = the number of statements made on management as a percentage of the total number of statements made on all aspects of each proposal, multiplied by 10 (allowing comparison of the evaluations of BIL and TRI).

Table A.4.1 below shows which individual venture capitalists dominated the total number of statements made on the most commented-upon items of information in each proposal, namely management, marketing, product and financial information.

Table A.4.1 The extent to which any one venture capitalist dominates the total number of statements made on aspects of the BIL and TRI proposals.

	BIL			TRI		
	Participant	Number	%	Participant	Number	%
Management	17	9	17.3	14	8	16.3
	08	8	15.4	01	5	10.2
	16	7	13.5	16	4	8.2
			46.2			34.7
	13	6	11.5			
	14	6	11.5			
			69.2			
Marketing	17	12	14.1	12	8	12.7
	16	9	10.6	02	6	9.5
	13	7	8.2	08	5	7.9
			32.9	16	5	7.9
				17	5	7.9
	03	6	7.1			
	02	5	5.9			45.9
			45.9			
Product	17	9	11.3	01	9	12.9
	01	8	10.0	13	6	8.6
	13	7	8.8	03	5	7.1
	15	7	8.8	09	5	7.1
	03	6	7.5	10	5	7.1
				21	5	7.1
			46.4			
						49.9

... continued

Table A.4.1 (continued)

Financials	06	12	11.0	08	12	14.0
	13	10	9.2	02	11	12.8
	11	9	8.3	13	8	9.3
				16	8	9.3
			28.5			
	17	8	7.3			45.4
	21	8	7.3			
			43.1			
Total number of statements made.	17	44	10.0	08	32	8.3
	13	35	7.9	01	30	7.8
	16	35	7.9	16	30	7.8
	06	31	7.1	02	29	7.5
	15	29	6.6	03	25	6.5
				10	25	6.5
			39.5			
						44.4

Appendix 4.1

Total Number of Identifiably Separate Statements made on the Brookfield Instruments and Tissue Reproductions Inc. Business Proposals.

Table A.4.2.1 Brookfield Instruments Ltd.

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Stage of company development	Comments on plan	Total
1	1	4	8	6		1	5	2	27
	3.7	14.8	29.6	22.2		3.7	18.5	7.4	100.0
	1.9	4.7	10.0	5.5		5.3	20.0	4.9	N/A
	2.3	9.1	18.2	13.6		2.3	11.4	4.5	61.4
2		5	4	1	3		1	2	16
		31.3	25.0	6.3	18.8		6.3	12.5	100.0
		5.9	5.0	0.9	10.3		4.0	4.9	N/A
		11.4	9.1	2.3	6.8		2.3	4.5	36.4
3	2	6	6	5	3		1	1	24
	8.3	25.0	25.0	20.8	12.5		4.2	4.2	100.0
	3.9	7.1	7.5	4.6	10.3		4.0	2.4	N/A
	4.5	13.6	13.6	11.4	6.8		2.3	2.3	54.5
4	1		3	3	2		2		11
	9.1		27.3	27.3	18.2		18.2		100.0
	1.9		3.7	2.8	6.9		8.0		N/A
	2.3		6.8	6.8	4.5		4.5		24.9

Table A.4.2.1 Brookfield Instruments Ltd. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Stage of company development	Comments on plan	Total
5		1	2	4	1		4	4	16
		6.3	12.5	25.0	6.3		25.0	25.0	100.0
		1.2	2.5	3.7	3.4		16.0	9.8	N/A
		2.3	4.5	9.1	2.3		9.1	9.1	36.4
6	1	4	5	12	1	2	1	5	31
	3.2	12.9	16.1	38.7	3.2	6.5	3.2	16.1	100.0
	1.9	4.7	6.3	11.0	3.4	10.5	4.0	12.2	N/A
	2.3	9.1	11.4	27.3	2.3	4.5	2.3	11.4	70.6
7	1	3	2	5		1			12
	8.3	25.0	16.7	41.7		8.3			100.0
	1.9	3.5	2.5	4.6		5.3			N/A
	2.3	6.8	4.5	11.4		2.3			27.3
8	8	3	3	7	2	1	2	1	27
	29.6	11.1	11.1	25.9	7.4	3.7	7.4	3.7	100.0
	15.4	3.5	3.8	6.4	6.9	5.3	8.0	2.4	N/A
	18.2	6.8	6.8	15.9	4.5	2.3	4.5	2.3	61.3
9		2	3		2			1	8
		25.0	37.5		25.0			12.5	100.0
		2.4	3.8		6.9			2.4	N/A
		4.5	6.8		4.5			2.3	18.1
10	1	1	2	3	1	2	1		11
	9.1	9.1	18.2	27.3	9.1	18.2	9.1		100.0
	1.9	1.2	2.5	2.8	3.4	10.5	4.0		N/A
	2.3	2.3	4.5	6.8	2.3	4.5	2.3		25.0

Table A.4.2.1 Brookfield Instruments Ltd. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Stage of company development	Comments on plan	Total
11	1	2	5	9	2	3		1	23
	4.3	8.7	21.7	39.1	8.7	13.0		4.3	100.0
	1.9	2.4	6.3	8.3	6.9	15.8		2.4	N/A
	2.3	4.5	11.4	20.5	4.5	6.8		2.3	52.3
12		2	2	1	1		2		8
		25.0	25.0	12.5	12.5		25.0		100.0
		2.4	2.5	0.9	3.4		8.0		N/A
		4.5	4.5	2.3	2.3		4.5		18.1
13	6	7	7	10	2	1		2	35
	17.1	20.0	20.0	28.6	5.7	2.9		5.7	100.0
	11.5	8.2	8.8	9.2	6.9	5.3		4.9	N/A
	13.6	15.9	15.9	22.7	4.5	2.3		4.5	79.4
14	6	4	3	3	1		4	2	23
	26.1	17.4	13.0	13.0	4.3		17.4	8.7	100.0
	11.5	4.7	3.8	2.8	3.4		16.0	4.9	N/A
	13.6	9.1	6.8	6.8	2.3		9.1	4.5	52.2
15	3	5	7	4	4	1		5	29
	11.1	18.5	25.9	14.8	14.8	3.7		18.5	100.0
	5.8	5.9	8.8	3.7	13.8	5.3		12.2	N/A
	6.8	11.4	15.9	9.1	9.1	2.3		11.4	66.0
16	7	9	3	6	2	3		5	35
	20.0	25.7	8.6	17.1	5.7	8.6		14.3	100.0
	13.5	10.6	3.8	5.5	6.9	15.8		12.2	N/A
	15.9	20.5	6.8	13.6	4.5	6.8		11.4	79.4

Table A.4.2.1 Brookfield Instruments Ltd. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Stage of company development	Comments on plan	Total
17	9	12	9	8	1	1		4	44
	20.5	27.3	20.5	18.2	2.3	2.3		9.1	100.0
	17.3	14.1	11.3	7.3	3.4	5.3		9.8	N/A
	20.5	27.3	20.5	18.2	2.3	2.3		9.1	100.1
18	1	5	1	5				1	13
	7.7	38.5	7.7	38.5				7.7	100.0
	1.9	5.9	1.3	4.6				2.4	N/A
	2.3	11.4	2.3	11.4				2.3	29.7
19	1	5		4	1	1			12
	8.3	41.7		33.3	8.3	8.3			100.0
	1.9	5.9		3.7	3.4	5.3			N/A
	2.3	11.4		9.1	2.3	2.3			27.4
20	1		4	5	1		1	4	16
	6.3		25.0	31.3	6.3		6.3	25.0	100.0
	1.9		5.0	4.6	3.4		4.0	9.8	N/A
	2.3		9.1	11.4	2.3		2.3	9.1	36.5
21	2	5	1	8		1	1	4	16
	10.5	26.3	5.3	42.1		5.3	5.3	5.3	100.0
	3.9	5.9	1.3	7.3		5.3	4.0	2.4	N/A
	4.5	11.4	2.3	18.2		2.3	2.3	2.3	43.3
Totals	52	85	80	109	30	18	25	41	440
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	N/A
	118.3	193.3	181.7	247.9	65.8	43.2	56.9	93.3	1000.4

Table A.4.2.2 Tissue Reproductions Inc.

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Comments on plan	Stage of company development	Location	Product liability	Total
1	5	2	9	6	1	1		1	2	3	30
	16.7	6.7	30.0	20.0	3.3	3.3		3.3	6.7	10.0	100.0
	10.2	3.2	12.9	7.0	4.8	14.3		9.1	16.7	7.0	N/A
	12.9	5.2	23.2	15.5	2.6	2.6		2.6	5.2	7.7	77.5
2	2	6	2	11	3		2	1		2	29
	6.9	20.7	6.9	37.9	10.3		6.9	3.4		6.9	100.0
	4.1	9.5	2.9	12.8	14.3		7.7	9.1		4.7	N/A
	5.2	15.5	5.2	28.4	7.7		5.2	2.6		5.2	75.0
3		4	5	2	6		1	2	2	3	25
		16.0	20.0	8.0	24.0		4.0	8.0	8.0	12.0	100.0
		6.3	7.1	2.3	28.6		3.8	18.2	16.7	7.0	N/A
		10.3	12.9	5.2	15.5		2.6	5.2	5.2	7.7	64.6
4	1			1			1	1	2	1	7
	14.3			14.3			14.3	14.3	28.6	14.3	100.0
	2.0			1.2			3.8	9.1	16.7	2.3	N/A
	2.6			2.6			2.6	2.6	5.2	2.6	18.2
5	2	1	2	2			2	1		1	11
	18.2	9.1	18.2	18.2			18.2	9.1		9.1	100.0
	4.1	1.6	2.9	2.3			7.7	9.1		2.3	N/A
	5.2	2.6	5.2	5.2			5.2	2.6		2.6	28.6
6		1	2						1		4
		25.0	50.0						25.0		100.0
		1.6	2.9						8.3		N/A
		2.6	5.2						2.6		10.4

Table A.4.2.2 Tissue Reproductions Inc. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Comments on plan	Stage of company development	Location	Product liability	Total
7	1	1	2	1						2	7
	14.3	14.3	28.6	14.3						28.6	100.0
	2.0	1.6	2.9	1.2						4.7	N/A
	2.6	2.6	5.2	2.6						5.2	18.2
8	3	5	4	12			1	3	2	2	32
	9.4	15.6	12.5	37.5			3.1	9.4	6.3	6.3	100.0
	6.1	7.9	5.7	14.0			3.8	27.3	16.7	4.7	N/A
	7.7	12.9	10.3	30.9			2.6	7.7	5.2	5.2	82.5
9	1	1	5	1			1		1	.2	12
	8.3	8.3	41.7	8.3			8.3		8.3	16.7	100.0
	2.0	1.6	7.1	1.2			3.8		8.3	4.7	N/A
	2.6	2.6	12.9	2.6			2.6		2.6	5.2	31.1
10	3	4	5	3	3	2	1		1	3	25
	12.0	16.0	20.0	12.0	12.0	8.0	4.0		4.0	12.0	100.0
	6.1	6.3	7.1	3.5	14.3	28.6	3.8		8.3	7.0	N/A
	7.7	10.3	12.9	7.7	7.7	5.2	2.6		2.6	7.7	64.4
11	1	3	4	5		1		1		3	18
	5.6	16.7	22.2	27.8		5.6		5.6		16.7	100.0
	2.0	4.8	5.7	5.8		14.3		9.1		7.0	N/A
	2.6	7.7	10.3	12.9		2.6		2.6		7.7	46.4
12	5	8	2	1	1					3	20
	25.0	40.0	10.0	5.0	5.0					15.0	100.0
	10.2	12.7	2.9	1.2	4.8					7.0	N/A
	12.9	20.6	5.2	2.6	2.6					7.7	51.6

Table A.4.2.2 Tissue Reproductions Inc. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Comments on plan	Stage of company development	Location	Product liability	Total
13	1	3	6	8	2		1			1	22
	4.5	13.6	27.3	36.4	9.1		4.5			4.5	100.0
	2.0	4.8	8.6	9.3	9.5		3.8			2.3	N/A
	2.6	7.7	15.5	20.6	5.2		2.6			2.6	56.8
14	8	4	4	4			1			3	24
	33.3	16.7	16.7	16.7			4.2			12.5	100.0
	16.3	6.3	5.7	4.7			3.8			7.0	N/A
	20.6	10.3	10.3	10.3			2.6			7.7	61.8
15	3	1	4	6		1	3			1	19
	15.8	5.3	21.1	31.6		5.3	15.8			5.3	100.0
	6.1	1.6	5.7	7.0		14.3	11.5			2.3	N/A
	7.7	2.6	10.3	15.5		14.3	7.7			2.6	49.0
16	4	5	4	8	3	1	2			3	30
	13.3	16.7	13.3	26.7	10.0	3.3	6.7			10.0	100.0
	8.2	7.9	5.7	9.3	14.3	14.3	7.7			7.0	N/A
	10.3	12.9	10.3	20.6	7.7	2.6	5.2			7.7	77.3
17	2	5	3	5	1					3	19
	10.5	26.3	15.8	26.3	5.3					15.8	100.0
	4.1	7.9	4.3	5.8	4.8					7.0	N/A
	5.2	12.9	7.7	12.9	2.6					7.7	49.0
18	2	3	1	3	1			1	1	4	16
	12.5	18.8	6.3	18.8	6.3			6.3	6.3	25.0	100.0
	4.1	4.8	1.4	3.5	4.8			9.1	8.3	9.3	N/A
	5.2	7.7	2.6	7.7	2.6			2.6	2.6	10.3	41.3

Table A.4.2.2 Tissue Reproductions Inc. (continued)

Venture capitalist	Management	Marketing	Product	Finance	Competition	Ownership of product	Comments on plan	Stage of company development	Location	Product liability	Total
19	1	1	1	2			2				7
	14.3	14.3	14.3	28.6			28.6				100.0
	2.0	1.6	1.4	2.3			7.7				N/A
	2.6	2.6	2.6	5.2			5.2				18.2
20	2	1				1	6			2	12
	16.7	8.3				8.3	50.0			16.7	100.0
	4.1	1.6				14.3	23.1			4.7	N/A
	5.2	2.6				2.6	15.5			5.2	28.5
21	2	4	5	5			2			1	19
	10.5	21.1	26.3	26.3			10.5			5.3	100.0
	4.1	6.3	7.1	5.8			7.7			2.3	N/A
	5.2	10.3	12.9	12.9			5.2			2.6	51.7
Totals	49	63	70	86	21	7	26	11	12	43	388
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	N/A
	126.6	162.5	180.7	221.9	54.2	18.2	67.4	28.5	31.2	110.9	1002.1

A.4.3 The Frequency of Individual Statements.

Appendix 4.2 displays a content analysis of the frequency of occurence of individual statements making up the headings described above (section A.4.2) and in appendix 4.1. The format of the presentation is shown in the following example.

	Evaluation score.												
	1		2		3		4		5		6		Total
	BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI
1 MANAGEMENT.													
1.1 Management team experience.	1/	1	16/	13	9/	1	6/	6	3/	3	4/	4	39/ 28
1.2 Information provided on management team.			4/	8	6/	6	1/	3	1/	1	1/	3	13/ 21
Total:	1/	1	20/	21	15/	7	7/	9	4/	4	5/	7	52/ 49
2 MARKET.													
2.1 Opportunity presented by the marketplace.	1/		8/	6	7/	2	4/	2			2/	1	22/ 11
2.2 Potential customers.					7/		5/		3/		1/		16/
2.3 Establishing company's market credibility.	/	1	2/	2	1/	2	2/	2					5/ 7
2.4 Marketing objectives.			2/	7	1/	1	/	1					3/ 9
2.5 Sales and marketing strategy.	/	3	3/	13	2/	3	/	1			/	1	5/ 21
2.6 Use of product in the marketplace.					4/	1	2/						6/ 1
2.7 The selling cycle.	/	1	1/		1/	3	1/						3/ 4
2.8 After sales service/consultancy.					5/								5/
2.9 Relationship of new product to other company activities.			2/		2/				1/				5/
2.10 Access/approach to export markets.			8/		2/		2/						12/
2.11 Overall credibility of marketing effort/ strategy.	/	2	1/	5	1/	2					1/	1	3/ 10
Total:	1/	7	27/	33	33/	14	16/	6	4/		4/	3	85/ 63

On the left is a summary statement, under which related statements made by the participants was scored. To the right are the frequencies with which these statements were expressed. The frequencies are divided according to the weighting system described in section 4 of chapter 7, where 1 = absolute rejection, 2 = major rejection, 3 = minor rejection, 4 = neutral, 5 = minor acceptance and 6 = major acceptance. They are further divided according to whether the comment was made about BIL or TRI. Figures to the left of the oblique refer to BIL, to the right, TRI.

Appendix 4.2 Content Analysis of the Evaluations of the Brookfield Instruments Ltd. and Tissue Reproductions Inc. Business Proposals.

Table A.4.3.1 Summary of Content Analysis.

	Evaluation score.														Total	
	1		2		3		4		5		6					
	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI			BIL	TRI
1 MANAGEMENT.																
1.1 Management team experience.	1/	1	16/	13	9/	1	6/	6	3/	3	4/	4			39/	28
1.2 Information provided on management team.			4/	8	6/	6	1/	3	1/	1	1/	3			13/	21
Total:	1/	1	20/	21	15/	7	7/	9	4/	4	5/	7			52/	49
2 MARKET.																
2.1 Opportunity presented by the marketplace.	1/		8/	6	7/	2	4/	2			2/	1			22/	11
2.2 Potential customers.					7/		5/		3/		1/				16/	
2.3 Establishing company's market credibility.	/	1	2/	2	1/	2	2/	2							5/	7
2.4 Marketing objectives.			2/	7	1/	1	/	1							3/	9
2.5 Sales and marketing strategy.	/	3	3/	13	2/	3	/	1			/	1			5/	21
2.6 Use of product in the marketplace.					4/	1	2/								6/	1
2.7 The selling cycle.	/	1	1/		1/	3	1/								3/	4
2.8 After sales service/consultancy.					5/										5/	
2.9 Relationship of new product to other company activities.			2/		2/				1/						5/	
2.10 Access/approach to export markets.			8/		2/		2/								12/	
2.11 Overall credibility of marketing effort/ strategy.	/	2	1/	5	1/	2					1/	1			3/	10
Total:	1/	7	27/	33	33/	14	16/	6	4/		4/	3			85/	63

Table A.4.3.1 (continued)

Evaluation score.

	1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
3 PRODUCT.							
3.1 Description of product.		2/ 2	4/ 3	4/ 1	5/ 3	1/ 3	16/ 12
3.2 Product characteristics.		3/ 5	5/ 4	3/	7/ 1	1	19/ 10
3.3 Manufacture of product.		10/ 13	2/ 4	10/	3		25/ 17
3.4 Quality control.		2/	2/ 2	1/			5/ 2
3.5 Research and development.	1/	4/ 3	3/ 2	/ 1	1/	/ 1	9/ 7
3.6 Proprietory position of technology.	1/	7/ 6	7/ 6	2/ 2	1/		18/ 14
3.7 Product's competitive edge.	1/	2/ 1	3/ 2				6/ 3
3.8 Clinical use of product.		/ 1	/ 7	/ 4			/ 12
Total:	3/	30/ 31	26/ 30	20/ 8	17/ 4	2/ 4	98/ 77
4 FINANCIALS.							
4.1 Presentation (1).	1/	10/ 7	14/ 5	/ 2			25/ 14
4.2 Presentation (2).		3/ 4	8/ 6		2/		13/ 10
4.3 Credibility of financial data.		8/ 8	2/ 1	/ 1			10/ 10
4.4 Amount of finance sought.		5/ 4	9/ 3	/ 2	3/		17/ 9
4.5 Operating costs of firm.	/ 2	12/ 11	7/ 4		1/		20/ 17
4.6 Financial characteristics of firm.	1/	1/ 6	4/ 4		3/		9/ 10
4.7 Investor expectations.	2/	6/ 12	2/ 2	2/	2/ 1	1/ 1	15/ 16
Total:	4/ 2	45/ 52	46/ 25	2/ 5	11/ 1	1/ 1	109/ 86

Table A.4.3.1 (continued)

	Evaluation score.												Total	
	1		2		3		4		5		6			
	BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI		BIL/TRI	
5 COMPETITION.														
5.1 Information on competitors - general.			6/		7/	5	1/		2/				16/	5
5.2 Attention paid to competitors.			2/	3	2/	3							4/	6
5.3 Vulnerability to competition.	1/		8/	8	1/	2							10/	10
Total:	1/		16/	11	10/	10	1/		2/				30/	21
6 STAGE OF COMPANY DEVELOPMENT.	2/	6	4/	3	6/	2	5/		5/		3/		25/	11
7 COMMENTS ON PROPOSAL.	1/	1	9/	8	13/	5	4/	3	14/	4	/	5	41/	26
8 GEOGRAPHIC LOCATION OF ENTERPRISE. (TRI only)	/	7	/	1			/	3	/	1			/	12
9 PRODUCT LIABILITY. (TRI only)	/	1	/	22	/	11	/	8	/	1			/	43

Table A.4.3.2 Frequency of Statements made on the Brookfield Instruments Ltd. and Tissue Reproductions Inc. Business Proposals.

1 MANAGEMENT.

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
1.1 Management team experience.							
1.1.1 Management team business experience/ competence: general		6/ 4	2/ 1	1/ 4	2/ 2	3/ 3	14/ 14
1.1.2 'Scientists, not businessmen'		1/ 5					1/ 5
1.1.3 Technical expertise			1/		/ 1	/ 1	1/ 2
1.1.4 Marketing expertise	/ 1	/ 1				1/	1/ 2
1.1.5 Manufacturing expertise		2/ 1	2/	4/	1/		9/ 1
1.1.6 Financial expertise		1/		/ 1			1/ 1
1.1.7 Completeness of management team	1/	6/ 2	4/	1/ 1			12/ 3
1.1 Total:	1/ 1	16/ 13	9/ 1	6/ 6	3/ 3	4/ 4	39/ 28
1.2 Information provided on management team.							
1.2.1 Adequacy of information on management team		1/ 3	2/ 2	1/ 2	/ 1	/ 1	4/ 9
1.2.2 Management team structure		3/ 3	1/ 3	/ 1		1/	5/ 7
1.2.3 Management team's c.v.			1/				1/
1.2.4 Management team commitment (financial/ personal)		1	1/ 1			/ 2	1/ 4
1.2.5 Employees		/ 1	1/		1/		2/ 1
1.2 Total:		4/ 8	6/ 6	1/ 3	1/ 1	1/ 3	13/ 21

Table A.4.3.2 (continued)

2 MARKETING.

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
2.1 Opportunity presented by the marketplace.							
2.1.1 Size of market		3/ 3				/ 1	3/ 4
2.1.2 Evidence for size of market		1/ 2	3/	2/			6/ 2
2.1.3 Growth rate of market, potential for growth, evidence for		1/	3/	1/ 1		2/	7/ 1
2.1.4 Summary of opportunity, adequacy of information provided	1/	3/ 1	1/ 2	1/ 1			6/ 2
2.1 Total:	1/	8/ 6	7/ 2	4/ 2		2/ 1	22/ 11
2.2 Potential customers (BIL only).							
2.2.1 Validity of identifying potential customers			6/	1/	3/	1/	11/
2.2.2 Will they buy it				3/			3/
2.2.3 Information on them			1/	1/			2/
2.2 Total:			7/	5/	3/	1/	16/
2.3 Company's market credibility.							
2.3.1 Task of breaking into markets (includes brand loyalty, cedibility)		2/	1/	2/			5/
2.3.2 Acceptance into markets (credibility, peer recommendation, conservatism of users)	/ 1	/ 2	/ 2	/ 2			/ 7
2.3 Total:	/ 1	2/ 2	1/ 2	2/ 2			5/ 7

Table A.4.3.2 (continued)

MARKETING (continued)	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
2.4 Marketing objectives.							
2.4.2 Credibility and attainability of sales targets and forecasts.		2/ 1	1/	/ 1			3/ 2
2.4.4 Timescale to achieving objectives		/ 1					/ 1
2.4.5 Evidence for share of market		/ 2					/ 2
2.4.6 Share of market aimed for		/ 3	/ 1				/ 4
2.4 Total:		2/ 7	1/ 1	/ 1			3/ 9
2.5 Sales and marketing strategy.							
2.5.1 Credibility of strategy outlined	/ 1	2/ 5	/ 2	/ 1		/ 1	2/ 10
2.5.2 Credibility of strategy adopted		/ 3	/ 1				/ 4
2.5.3 Size of sales force required		1/ 1	2/				3/ 1
2.5.4 Media plan	/ 1						/ 1
2.5.5 Advertising and promotion costs	/ 1						/ 1
2.5.6 Advertising strategy (including timing of advertising)		/ 4					/ 4
2.5 Total:	/ 3	3/ 13	2/ 3	/ 1		/ 1	5/ 21
2.6 Use of product in the marketplace.							
2.6.1 How it will be used/how often/by whom/ what for			2/ 1	2/			4/ 1
2.6.2 Product life cycle			2/				2/
2.6 Total:			4/ 1	2/			6/ 1

Table A.4.3.2 (continued)

MARKETING (continued)	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
2.7 The selling cycle.							
2.7.1 Timescale for individual sale		1/	1/	1/			3/
2.7.2 Decision making	/ 1						/ 1
2.7.4 Basis for selling (insurance)			/ 3				/ 3
2.7 Total:	/ 1	1/	1/ 3	1/			3/ 4
2.8 After sales service/consultancy (BIL only).							
2.8.1 Service back-up			3/				3/
2.8.2 Warranties/guarantees			1/				1/
2.8.3 Production of reagents			1/				1/
2.8 Total:			5/				5/
2.9 Relationship of new product to other company activities (BIL only).							
2.9.1 'Fit' of new product to existing range			1/		1/		2/
2.9.2 Sales effort for existing range		2/	1/				3/
2.9 Total:		2/	2/		1/		5/

Table A.4.3.2 (continued)

MARKETING (continued)	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
2.10 Access/approach to export markets (BIL only)							
2.10.1 Strategy for approaching export markets		8/	2/	1/			11/
2.10.2 Distributor networks				1/			1/
2.10 Total:	-- --	8/ --	2/ --	2/ --	-- --	-- --	12/ --- ---
2.11 Overall credibility of marketing strategy.							
2.11.1 Adequacy of sales and marketing effort		1/ 3	1/				2/ 3
2.11.2 Description of/information provided on sales and marketing effort	/ 1	/ 2	.			1/	/ 3 1/ 1
2.11.3 Company's marketing expertise (who's in charge)	/ 1						
2.11.5 Awareness of need to market product			/ 1			/ 1	/ 2
2.11.6 Relationship of marketing strategy to product liability issues			/ 1				/ 1
2.11 Total:	-- -- / 2	-- -- 1/ 5	-- -- 1/ 2	-- --	-- --	-- -- 1/ 1	--- --- 3/ 10

Table A.4.3.2 (continued)

3 PRODUCT.	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
3.1 Description of product							
3.1.1 Technical explanation		1/	1/		2/ 1	/ 3	4/ 4
3.1.2 Understanding of the technology ('feel/empathy')		/ 2	/ 2	1/	1/ 1	1/	3/ 5
3.1.3 Interest in the project			2/ 1	3/ 1	1/ 1		6/ 3
3.1.4 Ability to evaluate technology		1/					1/
3.1.5 What is the product designed to do (employment substitution)			1/		1/		2/
3.1 Total:	-- --	-- -- 2/ 2	-- -- 4/ 3	-- -- 4/ 1	-- -- 5/ 3	-- -- 1/ 3	--- --- 16/ 12
3.2 Product characteristics.							
3.2.1 Stage (status) of development		1/ 3	2/ 1	2/	6/		11/ 4
3.2.2 Timescale required to complete development		2/ 1	1/ 1				3/
3.2.3 Credibility/feasibility/viability of product		/ 1	1/ 2	1/	/ 1		2/ 4
3.2.4 Characteristics of product - general			1/		1/	1/	3/
3.2 Total:	-- --	-- -- 3/ 5	-- -- 5/ 4	-- -- 3/	-- -- 7/ 1	-- -- 1/	--- --- 19/ 10

Table A.4.3.2 (continued)

PRODUCT (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
3.3 Manufacture of product.							
3.3.1 Suitability (ability) of company to manufacture product		7/ 4	2/	5/			14/ 4
3.3.2 Strategy adopted: (i) sales to manufacturing switch		1/			2/		3/
3.3.3 Strategy adopted: (ii) manufacturing via assembly of components				1/	1/		2/
3.3.4 Why manufacture? (let Vanguard Biotechnics manufacture product)		2/		1/			3/
3.3.5 Subcontracting component manufacture				2/			2/
3.3.6 Source of components				1/			1/
3.3.7 Source of supplies (reagents, cell machines, includes delivery time)		/ 4	/ 3				/ 7
3.3.8 Cell machines (need for production, credibility of 'cell machines')		/ 3					/ 3
3.3.9 Scale-up of process for manufacture		/ 2	/ 1				/ 3
3.3 Total:		10/ 13	2/ 4	10/	3/		25/ 17
3.4 Quality control.							
3.4.1 Success rate/efficiency of production			/ 2				/ 2
3.4.2 Reliability in use		2/	2/	1/			5/
3.4 Total:		2/	2/ 2	1/			5/ 2

Table A.4.3.2 (continued)

PRODUCT (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
3.5 Research and development							
3.5.1 Commitment to this product and relationship of this commitment to follow-on products	1/	1/ 2	1/	/ 1	1/		4/ 3
3.5.2 Commitment to follow-on products		3/ 1	2/ 2			/ 1	5/ 4
3.5 Total:	1/	4/ 3	3/ 2	/ 1	1/	/ 1	9/ 7
3.6 Proprietory position of technology							
3.6.1 Why do they have manufacturing rights?				1/			1/
3.6.2 Ownership of technology	1/	3/ 3	1/ 3	1/ 1			6/ 7
3.6.3 Royalty/licensing arrangements, information on		4/	4/ 3				8/ 4
3.6.4 Licensing arrangements with distributors			2/				2/
3.6.5 Patentability of technology		/ 3			1/		1/ 3
3.6 Total:	1/	7/ 6	7/ 6	2/ 2	1/		18/ 14
3.7 Product's competitive edge							
3.7.1 Uniqueness		2/ 1	/ 2				2/ 3
3.7.2 How it is differentiated from other products	1/		1/				2
3.7.3 Advantage(s) over existing procedures			1/				1/
3.7.4 What other products are available?			1/				1/
3.7 Total:	1/	2/ 1	3/ 2				6/ 3

Table A.4.3.2 (continued)

PRODUCT (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
3.8 Clinical use of product (TRI only).							
3.8.1 Where will plastic surgeons publish findings?			/ 3	/ 1			/ 4
3.8.2 How were they chosen?			/ 1				/ 1
3.8.3 Users' opinion of product			/ 2	/ 2			/ 4
3.8.4 End user acceptance		/ 1	/ 1	/ 1			3
3.8 Total:		/ 1	/ 7	/ 4			/ 12

Table A.4.3.2 (continued)

4 FINANCIALS.	Evaluation score.													
	1		2		3		4		5		6		Total	
	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI
4.1 Presentation (1)														
4.1.1 Summary of opportunity/overall impression			2/	2	1/	3	/	1					3/	6
4.1.2 Adequacy of information - general			2/	4	/	2	/	1					2/	7
4.1.3 Adequacy of information - historical performance			3/	1	9/								12/	1
4.1.4 Adequacy of information - forward projections	1/		3/		4/								8/	
4.1 Total:	1/		10/	7	14/	5	/	2					25/	14
4.2 Presentation (2)														
4.2.1 Detail of presentation of forecasts - insufficient					1/	2							1/	2
4.2.2 Detail of presentation of forecasts - too detailed					1/	3							1/	3
4.2.3 Clarity of presentation			/	2	2/	1							2/	3
4.2.4 Breakdown of operating costs/expenditure/ budgets			/	2					1/				1/	2
4.2.5 Information on exchange rates					2/				1/				3/	
4.2.6 Evidence that sensitivity analysis considered/adequacy of			3/		2/								5/	
4.2 Total:			3/	4	8/	6			2/				13/	10

Table A.4.3.2 (continued)

FINANCIALS (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
4.3 Credibility of financial data							
4.3.1 Confidence/plausibility/credibility/ acceptability of forecasts/financial data		6/ 4	/ 1				6/ 5
4.3.2 Accuracy - incidence of incorrect figures/ mistakes		2/ 3					2/ 3
4.3.3 Assumptions behind forecasts		/ 1	2/	/ 1			2/ 2
4.3 Total:		8/ 8	2/ 1	/ 1			10/ 10
4.4 Amount of finance sought							
4.4.1 In relation to venture capitalist's deal screening criteria		1/	1/		1/		3/
4.4.2 Adequacy for project		3/ 2	4/ 1		1/		8/ 3
4.4.3 Why is cash wanted/what is it needed for?		/ 2	3/ 2				3/ 4
4.4.4 Use of funds			1/		1/		2/
4.4.5 Proprietors' own financial commitment		1/		/ 1			1/ 1
4.4.6 Suitability for syndication				/ 1			/ 1
4.4 Total:		5/ 4	9/ 3	/ 2	3/		17/ 9

Table A.4.3.2 (continued)

FINANCIALS (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
4.5 Operating costs of firm							
4.5.1 Cost basis of company - general		3/ 1	/ 1				3/ 2
4.5.2 Pricing of machine		1/					1/
4.5.3 Allowance for contingencies		3/ 1					3/ 1
4.5.5 Price elasticity			/ 1				/ 1
4.5.6 Margins, adequacy of (includes how much paid for product)	/ 1	4/ 1	4/				8/ 2
4.5.7 Salaries					1/		1/
4.5.8 Payment terms for product			2/ 1				2/ 1
4.5.9 Financial commitment to research and development		/ 5	/ 1				/ 6
4.5.10 Gross profit - adequacy	/ 1						/ 1
4.5.11 Breakdown of operating costs		1/ 3	1/				2/ 3
4.5 Total:	/ 2	12/ 11	7/ 4		1/		20/ 17

Table A.4.3.2 (continued)

FINANCIALS (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
4.6 Financial characteristics of firm							
4.6.1 Information on/economic basis of firm		/ 2	2/ 1				2/ 3
4.6.2 Current financial status of firm	1/	/ 1			2/		3/ 1
4.6.3 Funding structure of firm, information on		/ 1	/ 1				/ 2
4.6.4 Pricing of deal (too high)		1/	1/				2/
4.6.5 Valuation of company			/ 1				/ 1
4.6.6 Acquisition programme		/ 2	/ 1				/ 3
4.6.7 Financial characteristics in absence of new product		/ 4	1/ 3		1/		2/ 7
4.6 Total:	1/	1/ 6	4/ 4		3/		9/ 10
4.7 Investor expectations							
4.7.1 Expectations of reward	1/	5/ 3	1/		1/	/ 1	7/ 4
4.7.2 Amount of profit forecast	1/	/ 2					1/ 2
4.7.3 Risk:reward ratio		/ 2	1/				1/ 2
4.7.4 Timescale to profit		1/ 4	/ 1		1/		2/ 5
4.7.5 Potential for exit		/ 1			/ 1	1/	1/ 2
4.7.6 What company is expected to become			1/ 1				1/ 1
4.7.7 Appropriateness of venture capital funding				2/			2/
4.7 Total:	2/	6/ 12	2/ 2	2/	2/ 1	1/ 1	15/ 16

Table A.4.3.2 (continued)

5 COMPETITION.	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
5.1 Information on competitors - general (includes who are they and information provided about them)							
5.1.1 Extent and amount of competition		1/	3/ 2	1/			5/ 2
5.1.2 Strength/degree to which existing competition is established and the threat they pose		4/	3/ 1		2/		9/ 1
5.1.3 Validity of identifying competition		1/					1/
5.1.4 What is the split of existing market share?			/ 1				/ 1
5.1.5 What are the alternative technologies/ products?			1/ 1				1/ 1
5.1 Total:		6/	7/ 5	1/	2/		16/ 5
5.2 Attention paid to competitors							
5.2.1 Does the product merit competition? (ie - why is there no competition, why aren't they developing this product, are markets large enough to warrant developing this product?)		1/ 1	/ 2				1/ 3
5.2.2 Degree of seriousness with which competition is treated		1/ 2	2/ 1				3/ 3
5.2 Total:		2/ 3	2/ 3				4/ 6

Table A.4.3.2 (continued)

COMPETITION (continued).

	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
5.3 Vulnerability to competition							
5.3.1 Technical edge of product (are these serious advantages?)	1/	2/ 1					3/ 1
5.3.2 Price advantage of product		2/ 1	1/				3/ 1
5.3.3 Barriers to entry (what will prevent competition making an alternative product, what are the barriers?)		4/ 6	/ 2				4/ 8
5.3 Total:	1/	8/ 8	1/ 2				10/ 10

Table A.4.3.2 (continued)

6 STAGE OF COMPANY DEVELOPMENT.	Evaluation score. 1 BIL/TRI	2 BIL/TRI	3 BIL/TRI	4 BIL/TRI	5 BIL/TRI	6 BIL/TRI	Total BIL/TRI
6.1 Already up and running/ an existing business			2/	2/	4/	2/	10/
6.2 An existing business with a start-up superimposed	1/			1/	1/	1/	4/
6.3 Too early/a start up	/ 6		1/	2/			3/ 6
6.4 Isn't an operation of scale	1/						1/
6.5 Why manufacture? - stay as a sales/service company		1/	1/				2/
6.6 More appropriate for a joint venture		/ 3	/ 2				/ 5
6.7 Relationship to Vanguard		3/	2/				5/
Total:	2/ 6	4/ 3	6/ 2	5/	5/	3/	25/ 11

7 COMMENTS ON PROPOSAL.							
7.1 Information provided (i) (does it sell the proposition successfully/ is it a reasonably constituted plan?)	1/ 1	6/ 3	12/ 1	2/ 3	9/ 4	/ 5	30/ 17
7.2 Information provided (ii) (contents/layout/presentation)		3/ 5	1/ 4	2/	5/		11/ 9
Total:	1/ 1	9/ 8	13/ 5	4/ 3	14/ 4	5	41/ 26

Table A.4.3.2 (continued)

	Evaluation score.												Total	
	1		2		3		4		5		6			
8 GEOGRAPHIC LOCATION OF ENTERPRISE. (TRI only)	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI	BIL	TRI
8.1 US based	/	7											/	7
8.2 Would have been interested if based in UK							/	1	/	1			/	2
8.3 Growth within US			/	1			/	2					/	3
Total:	/	7	/	1			/	3	/	1			/	12
9 PRODUCT LIABILITY. (TRI only)														
9.1 The FDA process (what is it, how long does it take, stage in approval procedure)	/	1	/	4	/	4	/	5					/	14
9.2 FDA approval for creating 'patent cover'			/	3	/	5	/	2	/	1			/	11
9.3 (Attitude to) product liability (and side effects)			/	15	/	2	/	1	/				/	18
Total:	/	1	/	22	/	11	/	8	/	1			/	43

APPENDIX FIVE

THE USE OF CONTINGENCY TABLES AND THE CHI-SQUARE TEST FOR ASSOCIATION IN ANALYSING DATA PRESENTED IN THIS THESIS

Contents. Page.

List of tables.

A.5.1 Introduction.

The chi-square test is a measure of the degree of association between two variables. In this analysis, we were attempting to find if any association existed between (i) the evaluation score (our first variable) given for the Brookfield Instuments Ltd. (BIL) and Tissue Reproductions Inc. (TRI) business proposals and (ii) the assessment of variables derived from the Cope Pence score sheets.

A.5.2 Association between evaluation score and risk, return and liquidity variables.

It will be recalled that the 21 questions from this score sheet were first assigned to the risk, return and liquidity variables devised by Cope Pence. Tables A.5.1 on the next page presents the calculation of chi-square, based on this assignment, for Brookfield Instruments Ltd. Table A.5.2 which follows presents the calculation for Tissue Reproductions Inc.

A.5.3 Restrictions on the use of the chi-square test of association.

The validity of the chi-square test depends on a number of restrictions being observed, namely;

(i) frequency data must be used,

(ii) the expected value in any cell in the contingency table must never be less than 5,

(iii) the sum of the observed frequencies must equal the sum of the expected frequencies,

(iv) each score must be independent of every other score (Young and Veldman, 1981:509).

As will be seen in the calculation of chi-square in tables A.5.1 and A.5.2, there are a number of instances where the expected cell value is less than 5. This does throw some doubt on the validity of the chi-square statistic produced. In addition, there appears to be no association between evaluation score and these variables, suggesting that the partition of questions into these variables does not, in this instance, assist in the analysis of these score sheets. For these reasons, the questions were re-assigned to the product, market, financial and management variables, as explained in section 2 of chapter 10.

Table A.5.1 Brookfield Instruments Ltd.: calculation of chi-square values for risk, return and liquidity variables.

Key:

Observed score
(Expected score)
Chi-square contribution

1. Risk.

Eval. score	-ve	N	+ve	
1	14	10	12	36
	(13.5)	(9.3)	(13.3)	
	0.02	0.06	0.12	
2	17	9	6	32
	(12.0)	(8.2)	(11.8)	
	2.11	0.07	2.84	
3	33	25	45	103
	(38.5)	(26.5)	(37.9)	
	0.80	0.09	1.31	
	64	44	63	171

Chi-square = 7.42
No association, P > 0.10.

2. Return.

Eval score	-ve	N	+ve	
1	8	4	3	15
	(8.2)	(3.6)	(3.2)	
	0	0.04	0.01	
2	12	2	1	15
	(8.2)	(3.6)	(3.2)	
	1.76	0.71	1.51	
3	21	12	12	45
	(24.6)	(10.8)	(9.6)	
	0.53	0.13	0.60	
	41	18	16	75

Chi square = 5.31
No association, P> 0.20.

3. Liquidity.

Eval. score	-ve	N	+ve	
1	7	2	3	12
	(5.5)	(2.7)	(3.8)	
	0.43	0.20	0.16	
2	8	2	0	10
	(4.6)	(2.3)	(3.2)	
	2.59	0.03	3.15	
3	11	9	15	35
	(16.0)	(8.0)	(11.1)	
	1.54	0.13	1.41	
	26	13	18	57

Chi-square = 9.66
Association at 0.05 level.

Table A.5.2 Tissue Reproductions Inc.: calculation of chi-square values for risk, return and liquidity variables.

1. Risk.

Key:
Observed score
(Expected score)
Chi-square contribution

Eval. score	-ve	N	+ve	
1	45	12	26	83
	(39.8)	(10.9)	(32.3)	
	0.69	0.10	1.23	
2	29	7	24	60
	(28.7)	(7.9)	(23.4)	
	0	0.10	0.02	
4	6	3	15	24
	(11.5)	(3.2)	(9.3)	
	2.63	0.01	3.43	
	80	22	65	167

Chi-square = 8.21
No association, P > 0.10.

2. Return.

Eval score	-ve	N	+ve	
1	20	8	7	35
	(14.7)	(10.1)	(10.1)	
	1.90	0.45	0.97	
2	6	9	9	24
	(10.1)	(7.0)	(7.0)	
	1.66	0.60	0.60	
4	3	3	4	10
	(4.2)	(2.9)	(2.9)	
	0.34	0	0.42	
	29	20	20	69

Chi square = 6.95
No association, P> 0.20.

3. Liquidity.

Eval. score	-ve	N	+ve	
1	15	6	6	27
	(11.0)	(7.5)	(8.5)	
	1.45	0.30	0.74	
2	6	4	9	19
	(7.7)	(5.3)	(6.0)	
	0.39	0.31	1.52	
4	1	5	2	8
	(3.3)	(2.2)	(2.5)	
	1.57	3.47	0.11	
	22	15	17	54

Chi-square = 9.86
Association at 0.05 level.

A.5.4 Association between evaluation score and product, market, financial and management variables.

It will be noted that the contingency tables for BIL (table A.5.3 overleaf) contain a single evaluation score of 4. In the analysis of the data presented in the main body of the text, the chi-square values quoted have been calculated with this evaluation omitted. This is because the inclusion of this one value produces expected cell frequencies well below the acceptable minimum level required for valid chi-square testing to be conducted (ie expected cell frequencies should be greater than 5, as noted in section 7.2 of this appendix).

For the sake of completeness, this section presents chi-square values calculated both with and without this exceptional evaluation. Whilst the two calculations obviously produce different chi-square values, the degree of association for grouped variables demonstrated by the chi-square calculation is not substantially different whether this single evaluation is present or absent.

Table A.5.4 presents a sample calculation demonstrating the effect of including this evaluation. Table A.5.5 which follows shows the difference in chi-square values and levels of association caused by the inclusion of this single value.

Brookfield Instruments Ltd.

Table A.5.3 Contingency tables for individual variables.

1 Product.

Eval. score	-ve	N	+ve	
1	2	5	8	15
2	5	6	3	14
3	15	6	22	43
4	1	0	4	5
	23	17	37	77

2 Market.

Eval. score	-ve	N	+ve	
1	10	3	5	18
2	16	2	0	18
3	22	13	19	54
4	0	1	5	6
	48	19	29	96

3 Financials.

Eval. score	-ve	N	+ve	
1	10	5	3	18
2	13	3	0	16
3	23	15	14	52
4	1	3	2	6
	47	26	19	92

4 Management.

Eval. score	-ve	N	+ve	
1	7	3	2	12
2	4	1	4	9
3	9	7	17	33
4	0	1	3	4
	20	12	26	58

Table A.5.4 BIL: Contingency Tables combining two variables, with chi-square calculation.

Combined variables Product and Market;

(a) with evaluation 4 omitted.

Eval. score	-ve	N	+ve	
1	12	8	13	33
	(14.3)	(7.1)	(11.6)	
	0.36	0.11	0.17	
2	21	8	3	32
	(13.8)	(6.9)	(11.3)	
	3.72	0.17	6.16	
3	37	19	41	97
	(41.9)	(21.0)	(34.1)	
	0.58	0.18	1.39	
	70	35	57	162

Chi-square = 12.72
Association at 0.01 level.

(b) with evaluation 4 included.

Eval. score	-ve	N	+ve	
1	12	8	13	33
	(13.5)	(6.9)	(12.6)	
	0.18	0.19	0.01	
2	21	8	3	32
	(13.1)	(6.7)	(12.2)	
	4.72	0.27	6.95	
3	37	19	41	97
	(39.8)	(20.2)	(37.0)	
	0.20	0.07	0.43	
4	1	1	9	11
	(4.5)	(2.3)	(4.2)	
	2.73	0.73	5.49	
	71	36	66	173

Chi-square = 21.97
Association at 0.01 level.

Table A.5.5 Calculated chi-square values for BIL with single evaluation of 4 absent and present.

Variables	Single value omitted	Single value included
1. Product and Market.	Chi-square = 12.72 P < 0.01	Chi-square = 21.97 P < 0.01
2. Product and Financials.	Chi-square = 9.17 P > 0.05	Chi-square = 12.15 P > 0.05
3. Product and Management.	Chi-square = 4.72 P > 0.30	Chi-square = 7.52 P > 0.20
4. Market and Financials.	Chi-square = 21.16 P < 0.001	Chi-square = 30.35 P < 0.001
5. Market and Management.	Chi-square = 14.07 P < 0.01	Chi-square = 24.70 P < 0.001
6. Financials and Management.	Chi-square = 10.10 P < 0.05	Chi-square = 15.31 P < 0.02

A.5.5 Contingency tables and chi-square calculations for Brookfield Instruments Ltd. and Tissue Reproductions Inc.

In the contingency tables which follow, it will be noted that some expected values of less than 5 occur. This would appear to violate one of the conditions governing the validity of the chi-square test. However, Maxwell points out that, provided there are relatively few exceptions (for example, one cell out of nine may have an expected frequency of less than five) a minimum expected value of one is allowable in calculating chi-square (Maxwell, 1964:38).

Table A.5.6 BIL: Contingency Tables combining two variables, with chi-square calculation.

Key Observed frequency
(Expected frequency)
Chi-square contribution

Table 6.1 Product and Market

Eval. score	-ve	N	+ve	
1	12	8	13	33
	(14.3)	(7.1)	(11.6)	
	0.36	0.11	0.17	
2	21	8	3	32
	(13.8)	(6.9)	(11.3)	
	3.72	0.17	6.06	
3	37	19	41	97
	(41.9)	(21.0)	(34.1)	
	0.58	0.18	1.39	
	70	35	57	162

Chi-square = 12.72
Association at 0.02 level.

Table 6.2 Product and Financials

Eval. score	-ve	N	+ve	
1	12	10	11	33
	(14.2)	(8.4)	(10.4)	
	0.34	0.32	0.03	
2	18	9	3	30
	(12.9)	(7.6)	(9.5)	
	2.01	0.26	4.44	
3	38	21	36	95
	(40.9)	(24.1)	(30.1)	
	0.20	0.39	1.17	
	68	40	50	158

Chi-square = 9.17
No association, P > 0.05.

Table 6.3 Product and Management.

Eval. score	-ve	N	+ve	
1	9	8	10	27
	(9.0)	(6.0)	(12.0)	
	0	0.67	0.33	
2	9	7	7	23
	(7.7)	(5.1)	(10.2)	
	0.23	0.70	1.02	
3	24	13	39	76
	(25.3)	(16.9)	(33.8)	
	0.07	0.90	0.81	
	42	28	56	126

Chi-square = 4.72
No association, P > 0.30.

Table 6.4 Market and Financials.

Eval. score	-ve	N	+ve	
1	20	8	8	36
	(19.2)	(8.4)	(8.4)	
	0.03	0.02	0.02	
2	29	5	0	34
	(18.2)	(7.9)	(7.9)	
	6.47	1.08	7.92	
4	45	28	33	106
	(56.6)	(24.7)	(24.7)	
	2.38	0.44	2.79	
	94	41	41	176

Chi-square = 21.16
Association at 0.001 level.

Table 6.5 Market and Management.

Eval. score	-ve	N	+ve	
1	17	6	7	30
	(14.2)	(6.0)	(9.8)	
	0.57	0	0.80	
2	20	3	4	27
	(12.8)	(5.4)	(8.8)	
	4.12	1.09	2.63	
3	31	20	36	87
	(41.1)	(17.5)	(28.4)	
	2.48	0.35	2.04	
	68	29	47	144

Chi-square = 14.07
Association at 0.01 level.

Table 6.6 Financials and Management.

Eval. score	-ve	N	+ve	
1	17	8	5	30
	(14.1)	(7.3)	(8.6)	
	0.58	0.07	1.49	
2	17	4	4	25
	(11.8)	(6.1)	(7.1)	
	2.31	0.71	1.38	
3	32	22	31	85
	(40.1)	(20.6)	(24.3)	
	1.63	0.09	1.86	
	66	34	40	140

Chi-square = 10.10
Association at 0.05 level.

Tissue Reproductions Inc.

Table A.5.7 Contingency tables for individual variables.

1 Product.

Eval. score	-ve	N	+ve	
1	20	4	11	35
2	11	4	10	25
4	4	2	4	10
	35	10	25	70

2 Market.

Eval. score	-ve	N	+ve	
1	27	9	6	42
2	10	8	11	29
4	3	3	6	12
	40	20	23	83

3 Financials.

Eval. score	-ve	N	+ve	
1	23	9	9	41
2	10	7	12	29
4	3	4	5	12
	36	20	26	82

4 Management.

Eval. score	-ve	N	+ve	
1	10	4	14	28
2	10	1	9	20
4	0	2	6	8
	20	7	29	56

Table A.5.8 TRI: Contingency tables combining two variables, with chi-square calculation.

Key Observed frequency
(Expected frequency)
Chi-square contribution

Table 8.1 Product and Market

Eval. score	-ve	N	+ve	
1	47	13	17	77
	(37.7)	(15.1)	(24.2)	
	2.27	0.29	2.12	
2	21	12	21	54
	(26.5)	(10.6)	(16.9)	
	1.13	0.19	0.97	
4	7	5	10	22
	(10.8)	(4.3)	(6.9)	
	1.33	0.11	1.39	
	75	30	48	153

Chi-square = 9.80
Association at 0.05 level.

Table 8.2 Product and Financials

Eval. score	-ve	N	+ve	
1	43	13	20	76
	(35.5)	(15.0)	(25.5)	
	1.59	0.27	1.19	
2	21	11	22	54
	(25.2)	(10.7)	(18.1)	
	0.71	0.01	0.83	
4	7	6	9	22
	(10.3)	(4.3)	(7.4)	
	1.04	0.63	0.36	
	71	30	51	152

Chi-square = 6.62
No association, P > 0.10.

Table 8.3 Product and Management

Eval. score	-ve	N	+ve	
1	30	8	25	63
	(27.5)	(8.5)	(27.0)	
	0.23	0.03	0.15	
2	21	5	19	45
	(19.6)	(6.1)	(19.3)	
	0.09	0.20	0	
4	4	4	10	18
	(7.9)	(2.4)	(7.7)	
	1.89	1.02	0.68	
	55	17	54	126

Chi-square = 4.28
No association, P > 0.30.

Table 8.4 Market and Financials

Eval. score	-ve	N	+ve	
1	50	18	15	83
	(38.2)	(20.1)	(24.6)	
	3.62	0.22	3.78	
2	20	15	23	58
	(26.7)	(14.1)	(17.2)	
	1.69	0.06	1.94	
4	6	7	11	24
	(11.1)	(5.8)	(7.1)	
	2.31	0.24	2.10	
	76	40	49	165

Chi-square = 15.97
Association at 0.01 level.

Table 8.5 Market and Management

Eval. score	-ve	N	+ve	
1	37	13	20	70
	(30.2)	(13.6)	(26.2)	
	1.52	0.03	1.46	
2	20	9	20	49
	(21.2)	(9.5)	(18.3)	
	0.06	0.03	0.15	
4	3	5	12	20
	(8.6)	(3.9)	(7.5)	
	3.68	0.32	2.73	
	60	27	52	139

Chi-square = 9.98
Association at 0.05 level.

Table 8.6 Financials and Management

Eval. score	-ve	N	+ve	
1	33	13	23	69
	(28.0)	(13.5)	(27.5)	
	0.89	0.02	0.74	
2	20	8	21	49
	(19.9)	(9.6)	(19.5)	
	0	0.26	0.11	
4	3	6	11	20
	(8.1)	(3.9)	(8.0)	
	3.22	1.11	1.15	
	56	27	55	138

Chi-square = 7.51
No association, P > 0.10.

References.

Maxwell A.E., 1964, Analysing Qualitative Data, London: Methuen and Co. Ltd..

Young, R.K. and Veldman, D.J., 1981, Introductory Statistics for the Behavioral Sciences, Holt, Rinehart and Winston, 4th Edition.

BROOKFIELD INSTRUMENTS LIMITED

SUMMARY

This business plan introduces a proposal by Brookfield Instruments Ltd. to develop from a sales and service company supplying imported, automated, high value instrumentation to the UK biotechnology sector into a manufacturer of such equipment.

The company intends to continue to expand its successful sales and service function as a licensee of Vanguard Biotechnics Inc., an established US manufacturer of this type of equipment, whilst developing its own production facilities to bring to the market place equipment developed in the UK.

The first piece of equipment Brookfield is going to manufacture is an automated DNA sequencer, developed by the Polytechnic of Southampton's Department of Instrumentation. The prototype machine has been available as a working model for 15 months, during which time it has attracted considerable interest from potential users and other manufacturers. Brookfield have recently been successful in negotiating exclusive production licences with the Polytechnic authorities.

The market for this product is compatible with that already serviced by Brookfields existing product range.

In order to carry out its plans in a timely manner, Brookfield are seeking £250 000 either as debt finance, or in the form of equity participation in the company.

Biotechnology is widely regarded as being one of the major technologies of the next century, but also one in which commercial opportunities have been the hardest to identify. The automated instrumentation market is one of the few biotechnologies which have thus far demonstrated returns for the investor. For the product lines in which Brookfield are currently involved, total annual worldwide sales approach $100 million (£70 million), with growth estimated at 15% per annum for the next five years. This DNA sequencer project will enable Brookfield to establish itself as an internationally competitive manufacturer in this fast expanding industry.

CONTENTS

INTRODUCTION

Brookfield Instruments Limited was established in March 1983 at the Brookfield Innovation Centre, Milton Keynes. It is a sales and service company supplying a range of advanced automated instrumentation, manufactured in the United States by Vanguard Biotechnics Inc., to the UK biotechnology sector.

The products currently being marketed are:

VB 200 single channel DNA synthesiser
VB 400 multi-channel DNA synthesiser
VB APS 100 protein sequencer
VB PPS peptide sequencer

In addition, the company supplies the Vanguard Biotechnics High Performance Liquid Chromatography (HPLC) system for end product purification, and a range of chemicals for use with these machines. Brookfield also provide an after-sales servicing and consultation service. In the current trading year (ending February 1986), total sales income will be in excess of £900 000.

It was the original intention of the company to generate income from its current operations enabling an expansion into manufacturing instruments of this type. However, in May 1985 it came to our attention that an automated DNA sequencer had been successfully developed at Southampton Polytechnic and that the development team were looking for a company to undertake commercial production.

A machine of this type is not currently available, and in order to capitalise on this unique opportunity Brookfield approached the development team with regard to forming a collaborative production agreement. Following negotiation with the Polytechnic authorities, Brookfield have been successful in securing manufacturing rights for the machine.

At present there are no UK manufacturers of this type of equipment in what is an internationally expanding market. Initially, production will be an in-house assembly operation with components brought in from commercial sources and specialist sub-contractors. It is Brookfield's intention however to use the DNA sequencer project as a stepping stone to developing a manufacturing base from which a wider range of machines will eventually be produced. In this way, Brookfield intends to become a major internationally competitive manufacturer, commercialising both in-house R&D and licensing developments from UK research institutions.

COMPANY INFORMATION

Brookfield Instruments Limited was formed in March 1983 with an initial share capital of £1 000.

The founding directors are	James Martin Appleby BSc PhD Robert Lye BSc MBA

The directors each hold 50% of the companys equity.

Company address	Unit 4, Brookfield Innovation Centre, Milton Keynes, MK7 4BW. Tel. 0234 76132.
Company registration number	8142790
VAT registration number	4561177
Bank	Lloyds Bank PLC., Lloyds Gate, 28 Secklow Gate West, Milton Keynes.
Solicitors	Johnson and Co Ltd., 15 High Street, Bedford.
Accountants	Membury, Nephew and Membury, 43-45 Templegate Parkway, Milton Keynes.
Technical advisors	Dept. of Instrumentation and Automation, Southampton Polytechnic, London Road, Southampton.

A copy of the Memorandum and Articles of Association will be made available at a more appropriate date.

THE PRODUCT

A more detailed technical description of the DNA sequencer is presented in Appendix 1.

Identification of DNA sequences is of great importance to the development of biotechnology, but the procedure itself is time consuming, repetitive and labourious to perform manually. It is therefore ideal for automation.

The machine Brookfield intend to produce has been developed at the Polytechnic of Southampton by a team under the direction of Professor Michael Arthur, head of the Polytechnic's Department of Instrumentation and Automation. It has been available as a working prototype for 15 months, during which time it has been in regular use with the Polytechnic's Biochemistry Department. More recently, it has also been used for contract sequencing work. As a result of this 'hands on' experience, the machine has been continuously uprated, to improve its design and to take account of developments in DNA sequencing chemistry.

Chiefly as the result of an article in the Journal of Biotechnological Instrumentation and Control (Arthur, M., et al, 'Automation of the Sanger DNA sequencing procedure', J. Biot. Inst. Contr. 14, 3, 1985, pp. 74-81.), considerable interest has been shown in the machine by industrial and academic scientists. Our machine will enable these potential users to identify DNA sequences more rapidly, at greater efficiency, and at lower cost than is achievable by manual or semi-automated sequencing.

Practical experience of the machine in use at Southampton indicates that the purchase price of £35 000 can be recovered within 2 years, taking into account savings in technical staff, increased efficiency of reagent usage, and increased productivity.

MARKET ANALYSIS AND MARKETING

A. Industry description and outlook.

Automated instrumentation used in the analysis and synthesis of biologically active molecules (of the type currently marketed by Brookfield) has only become available over the last five years, but now accounts for total worldwide sales of $95m. (£68m.) per annum. The rate of growth of sales of this equipment is conservatively estimated at 15% annually.

The principal manufacturers of automated instrumentation by market share are:

Applied Biosystems (USA)	24.5%
Beckman Instruments (USA/Europe)	21.9%
VANGUARD BIOTECHNICS (USA)	17.4%
Vega Instruments (USA)	14.6%
Biosearch (USA)	8.5%
Others	13.1%

(NB. Not all companies market all products, and dates of introduction influence market shares)

The DNA sequencer that Brookfield will manufacture will enter a market with world sales estimated at 500 units per annum by 1990. The principle markets for this machine are those serviced by our existing product range, and are divided between the larger pharmaceutical and chemical companies, government supported research laboratories (including universities and polytechnics) and emerging new biotechnology companies.

The following is a list of some of the organisations who are potential customers for the DNA sequencer.

1. Established UK companies

Amersham International PLC
Beechams Pharmaceuticals
Fisons PLC
Glaxo Group Research Ltd.
Hoechst UK Ltd.
Imperial Chemical Industries PLC
MSD (UK) Ltd.
GD Searle and Co. Ltd.
Unilever PLC
Wellcome Biotechnology Ltd.

continued...

2. Universities/Polytechnics

University of Birmingham Biotechnology Management Group
University of Cambridge Biotechnoloy Centre
Cranfield Institute of Technology Biotechnology Centre
University of Edinburgh Dept. of Molecular Biology
University of Essex Molecular Genetics Group
University of Glasgow Biotechnology Group
University of Manchester Applied Molecular Biology Group
University College of Wales, Cardiff Biotechnology Group
University of Warwick Dept. of Biological Sciences

Polytechnic of Central London Institute for Biotechnological Studies
Manchester Polytechnic Biosciences Research Division
North-East London Polytechnic Dept. of Life Sciences
Portsmouth Polytechnic Biochemistry Department
Sunderland Polytechnic Molecular Biology and Biochemistry Division

3. Government Research Contractors, Contract Research Organisations

Agriculture and Food Research Council
Centre for Applied Microbiological Research
Hazelton Laboratories Europe Ltd.
Inveresk Research International Ltd.
John Innes Institute
Medical Research Council
Ministry of Agriculture, Food and Fisheries
National Environment Research Council
PA Technology Ltd.
Vincent Kennedy Ltd.

4. New Biotechnology Companies

ABM Chemicals Ltd.
Anglian Biotechnology Ltd.
Biocon (UK) Ltd.
Bioscot Ltd.
Celltech Ltd.
Imperial Biotechnology
Life Technologies Inc.
Merseyside Laboratories
Monotech Laboratories Ltd.
P and S Biochemicals Ltd.

continued...

5. An indication of principal US and European customers

Allelix (Canada)
Bethesda Research Laboratories Inc.(US)
Biogen Inc. (US/Switzerland)
Bristol Myers (US)
Cetus Corp. (US)
Ciba Geigy (Switzerland)
Dow Chemical Co. (US)
Eli Lilly (US)
Genentech Inc. (US)
Gist Brocades (Netherlands)
Hoffman la Roche (Switzerland/US)
Kabi Gen/Kabi Vitrum (Sweden)
Pharmacia (Sweden)
Rhone Poulenc (France)
Roussel Uclaf (France)
Sandoz (Switzerland)
Schering Plough Corp. (US)
GD Searle and Co. (US)
Syntex Research (US)

B. Target markets

Marketing of the DNA sequencer will be targetted primarily towards the larger industrial concerns. It is our experience that these companies generate sales more rapidly than either the small firm or academic sectors, and in the UK some 65% of automated instrument sales are to established pharmaceutical and chemical companies.

The academic sector accounts for 25% of current sales. Although biotechnology is identified as a priority area for research and has received special funding from the research councils, it is conceivable that this could change in response to increasing pressures on the science budget.

However, we expect the 10% of business presently conducted with new biotechnology companies to increase markedly over the next five years.

In broad terms the UK market is representative of the international situation, excepting that budgets for government sponsored research in biotechnology vary from country to country. Also, the new biotechnology company market share is more important in the US, accounting for some 17% of automated instrument sales for the half year to September 1985.

COMPETITOR PRODUCTS

The main alternative to automated DNA sequencing comes from existing methods of manual and semi-automated sequencing carried out in the laboratory. As has been previously mentioned, automation offers considerable advantages over these procedures. Some contract sequencing is undertaken, but this forms a relatively small proportion of the total amount of sequencing carried out for R&D purposes. Published sequences, available on commercial data bases, is a source of competition limited by the relatively small number of sequences available from these sources.

There are two distinct chemistries available for DNA sequencing, although it is unlikely that the the chemistry not being utilised in Brookfields machine could be automated in a commercially successful way, as it is neither as efficient or as inexpensive to perform as the chemistry employed in this development.

Currently, there are eight manufacturers worldwide actively engaged in producing automated instrumentation which is competitive to the Vanguard product range. It is known that one of these, a major US competitor, is currently engaged in the development of a DNA sequencer. The cost of this machine is likely to be around $60 000 (£43 000). It will use the same chemistry as that employed in our machine. The launch date is anticipated for sometime in the autumn or winter of 1986.

Although further details of this machine are not available, we have no reason to believe that it will offer any technical advantages over our own product. Likewise, running costs are unlikely to differ substantially. Where we do have an advantage is in purchase price, where the lower cost of our machine will make it more attractive to the customer.

If industry trends are repeated along the same lines as our existing product range, it seems inevitable that other competitors will in due course enter the market place with similar instruments.

Therefore by 1990 it would seem reasonable to assume that four machines, all with similar capabilities, will be available from various suppliers, competing for annual worldwide sales of 500 units. Brookfield will then have had equipment in use for at least four years, giving us an important advantage over any subsequent entrants to the market.

PROMOTION

Sales activities in the UK will initially be the responsibility of one director, although we anticipate the need for an extra sales person once the DNA sequencer is available on the market.

The experience of promoting and marketing our present product range will be invaluable in the promotion of the DNA sequencer. There is already considerable awareness of the machine amongst prospective customers and, during the final pre-launch phase, a direct mailing campaign will be initiated to consolidate this. We have already identified interested parties and key decision makers within our target groups. Attendance at trade fairs will help to further stimulate interest.

Promotion in overseas markets is the responsibility of the appointed agent. (See page 12 for a list of prospective export sales agencies). However, for the purposes of specialist journal advertising, a collaborative campaign to promote the DNA sequencer will be undertaken.

DISTRIBUTION

Distribution within the UK will be undertaken by Brookfield staff, who will be responsible for delivery, setting up the instrument, and training staff in its use.

Details of export distribution have still to be finalised. It is likely that for European sales, dispatch will be direct to the customer, as is the case with Vanguard's agreement with Brookfield on sales of their equipment in the UK. Given the higher sales we anticipate in the US, it may prove viable to stock items with our agencies there. This matter is currently being investigated.

Construction of the accounts assumes direct dispatch to all customers.

PRODUCTION

The level of sales forecast for the first year of operation and the current one product status of the company do not justify the investment in machinery and manpower required to set up an in-house manufacturing capability.

Production of the DNA sequencer will therefore initially be an assembly only operation with components (eg the Apple IIe microcomputer which controls the instrument) being brought in from commercial sources. Where specialised components are not available, manufacture will be contracted out to machine tool engineering companies in the Milton Keynes/Northampton area.

Production schedules have been prepared and quotations obtained from a number of sources. These indicate that component costs per machine will be £13 000. A breakdown of the production schedule and associated costs will be made available at a more appropriate date.

THE MANAGEMENT TEAM.

1) Dr Appleby's background is as a research scientist in molecular biology and genetic engineering, and he has extensive experience in R&D administration and management in academic and industrial settings. In recent years, he has become involved in automation procedures, and in his former position at Vanguard Biotechnics he was one of a small team responsible for organising the manufacture of that company's DNA synthesiser (eg. preparation of production schedules, pre-launch testing, trouble shooting, etc.). In addition, he has attended various courses on project and manpower management.

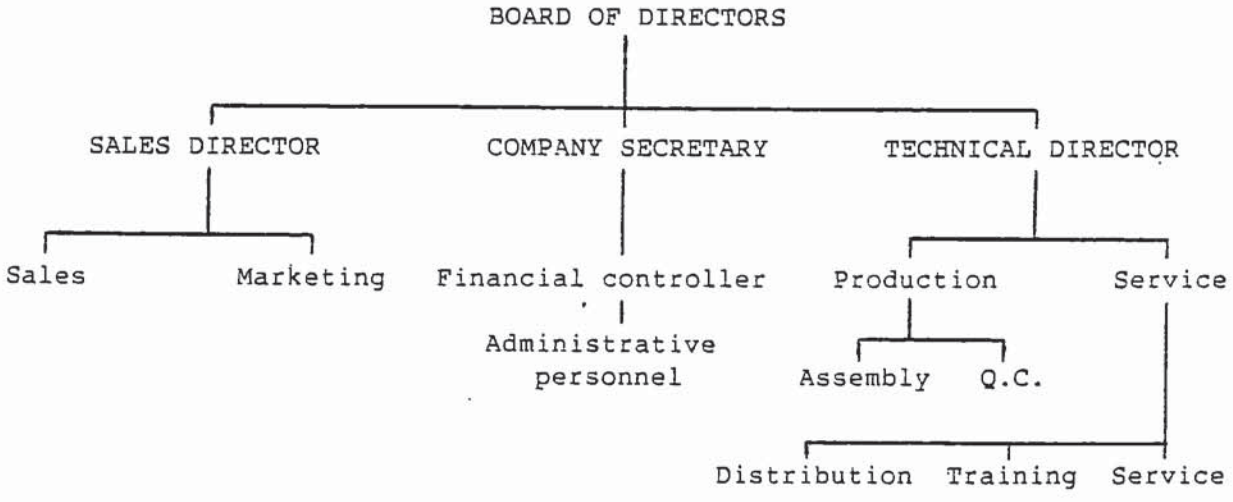
2) In the course of his career to date, Mr Lye has gained considerable experience in sales, marketing and company administration. He has been responsible for devising and successfully implementing marketing strategies (including new product launches) in both the pharmaceutical and instrumentation sectors, with Vanguard Biotechnics to senior management level. Besides directing sales and marketing, he also assists in training operators in the use of the companys products.

Detailed resumes of the directors are available in appendix 3.

3) George Pollard, ACMA, is Brookfields financial controller. Aged 57, he was financial controller at a medium sized machine tool manufacturing company for 20 years, until taking early retirement in 1983. He has detailed knowledge of production economics, and provides invaluable general management expertise and back up for the management team.

4) Andrew Scott will be the company's technical advisor on secondment from Southampton Polytechnic. He was involved as a research associate in the three year design and development of the DNA sequencer. He will join the company on a two year contract initially. Mr Scott is 28 years of age.

ORGANISATIONAL STRUCTURE



PERSONNEL

The following table indicates current and proposed staffing levels for the period that Brookfield develops its production operations.

		1986/7												1987/8											
	SALARY	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Production/Q.C.																									
Director	18 000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Engineer	12 500		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Engineer	12 000													X	X	X	X	X	X	X	X	X	X	X	X
Engineer	12 000																				X	X	X	X	X
Assembly																									
Technician	9 750													X	X	X	X	X	X	X	X	X	X	X	X
Technician	9 750													X	X	X	X	X	X	X	X	X	X	X	X
Technician	9 750													X	X	X	X	X	X	X	X	X	X	X	X
Techniciam	9 750													X	X	X	X	X	X	X	X	X	X	X	X
Technician	9 750													X	X	X	X	X	X	X	X	X	X	X	X
Technician	9 750																			X	X	X	X	X	X
Technician	9 750																			X	X	X	X	X	X
Technician	9 750																			X	X	X	X	X	X
Administration																									
Finance manager	12 300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Secretary (F/T)	7 400	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Secretary (P/T)	4 000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Secretary (F/T)	6 600														X	X	X	X	X	X	X	X	X	X	X
Sales/marketing																									
Director	18 000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sales rep.	13 400																		X	X	X	X	X	X	X

As the machine already exists as a fully operational prototype, the requirement for technical staff is largely negated. If required, extra staff from Southampton Polytechnic are available for consultation. This also means that research and development costs in general are limited.

The major recruitment areas for the company will be in machine assembly and product testing. We intend to employ well qualified personnel, with HNC as a minimum qualification, preferably with industrial experience.

We feel quality assurance is essential to the success of the venture, particularly in view of the likelihood of competition from other producers. Hence, the emphasis on quality of assembly and on pre-dispatch product testing, as reflected in the proposed staffing levels of these functions.

BASIS FOR TRADING

1) Sales and service operation

Brookfield Instruments Ltd. act as a UK licensee for Vanguard Biotechnics Inc. Brookfield's responsibilities are:

- marketing and selling Vanguards products in the UK,
- checking of equipment on arrival at the customers premises, and installation of equipment,
- training staff in the use of this equipment,
- providing after-sales consultation, service and repair.

Instruments are shipped direct from the United States to the UK customer.

Payment is made by the customer to Brookfield one calender month after date of purchase.

Payment by Brookfield to Vanguard is made two calender months after date of purchase.

Consumables are:

i) specialist chemicals and reagents supplied by Vanguard and used in the day to day operation of the machines,
ii) replacement items required for servicing and repairs.

Purchases of consumables are made on a quarterly basis in order to maintain stocks of these items. Reagents and chemicals compatible with the equipment are available from a number of UK sources, and there is no requirement to use Vanguard reagents and chemicals in Vanguard machines.

2) DNA Sequencer

Payment for DNA Sequencers will be made one month after date of purchase by UK customers.

Payment for export sales will be made two months after date of purchase.

An agents commission of 22% of sales price (£7.7K at £1 = $1.38) is payable on each export sale.

Reagents and chemicals used in the operation of the DNA sequencer are available from a variety of sources, and are the same as those used in manual procedures. There is no intention therefore on the part of the company to enter into consumables production at this time.

3) Export sales agencies

The following companies have been approached to act as agents for Brookfield in the markets listed.

Company	Country
Vanguard Biotechnics Inc.	USA
Lab Systems Inc.	USA
CLM Inc.	Canada
Bioteknika Gmbh.	West Germany
ENIEX S.A.	France
Simar-Gardansk NV	Benelux countries

Additional agencies for Europe will be appointed during the pre-production year.

Arrangements for entry into the Japanese and Far Eastern markets will be finalised over the coming year, and undertaken later in 1988.

NOTES TO THE ACCOUNTS

1) Description of products, and associated costs.

Machine	Description	Purchase price £ 000	Selling price £ 000
VB 200	Fully automated single channel DNA synthesiser.	28.7	36.1
VB 400	Fully automated multiple channel DNA synthesiser.	38.4	49.4
VB APS 100	Fully automated protein sequencer.	73.9	94.0
VB PPS	Fully automated peptide synthesiser	58.2	66.8
HPLC	Fully dedicated/stand-alone high performance liquid chromatography system.	10.5	14.0
DNA sequencer		15.0	35.0

2) Effect of change in exchange rates on cash inflow/outflow

The accounts have been prepared assuming a £:$ exchange rate of £1:$1.38. The table below indicates the effect of changes in this rate on sales income and cost of purchases, and the resultant change in annual cash inflow/outflow.

Year 1.

£ = $	Effect on income	Effect on purchases	Effect on expenses	Effect on net cash in/out.
1.20		917.1		(125.0)
1.25		880.4		(88.3)
1.30		846.6		(54.4)
1.35		815.2		(23.1)
1.38	938.5	797.5	246.4	(5.4)
1.40		786.1		6.0
1.45		759.0		33.1
1.50		733.7		58.4

Year 2.

1.20	1973.5	1306.8	637.3	29.4
1.25	1944.5	1271.9	630.9	41.7
1.30	1971.8	1239.7	625.0	52.3
1.35	1893.0	1209.9	619.6	63.5
1.38	1879.0	1193.1	616.5	69.4
1.40	1870.0	1182.3	614.5	73.5
1.45	1848.6	1156.5	609.8	82.3
1.50	1828.6	1132.4	605.4	90.8

3) USE OF FUNDS

The plan calls for £250 000 to be made available in the form of debt financing or as equity participation, or a combination of the two. The following capital expenditure is expected in the period to March 1988.

Specialist tools and equipment for assembly operations	£20 000.
Setting up and equiping evaluation laboratory	£60 000
Purchase of vehicles	£22 500
Purchase of office equipment and computer system	£13 500
Capitalisation of demonstration models	£35 000
Working capital	£100 000
Total	£250 000

PROFIT AND LOSS ACCOUNT SUMMARIES, FOR YEAR ENDING 28TH FEBRUARY

	1987			1988	
	£000	£000	£000	£000	£000
Sales					
Standard range (1)	940.0		966.0		
DNA Sequencer	-		840.0		
		940.0			1806.0
Purchases					
Standard range	783.0		804.0		
DNA Sequencer	-		390.0		
		783.0			1194.0
Added value			157.0		612.0
Variable costs					
Royalties	-		104.0		
Labour	-		78.0		
Agents commission	-		138.6		
Carriage, freight, insurance charges	-		8.0		
		-		328.6	
			157.0		283.4
Production: fixed costs					
Rent and rates	18.0		24.0		
Heat, light and power	6.0		9.4		
Depreciation	13.6		13.6		
Payroll	27.4		49.4		
Sundries	1.0		1.0		
		66.0		97.4	
Administration					
Payroll	23.8		30.3		
Post and stationery	3.5		4.0		
Telephone and telex	1.5		4.7		
Accounting and legal	2.2		2.5		
Interest charges	10.5		54.0		
Depreciation	2.5		5.5		
		44.0		101.0	
Selling and distribution					
Payroll	18.0		28.9		
Travel expenses	6.0		10.0		
Depreciation	1.5		2.7		
Carriage and packing	0.5		2.4		
		26.0		44.0	
			136.0		242.4
Operating surplus			21.0		41.0
R&D (Pre-production specifications, etc.)			25.0		35.0
Trading profit/loss			(4.0)		76.0
Taxation					22.0
Retained earnings					54.0

(1) Refers to standard non-manufactured items

BALANCE SHEET SUMMARIES, AT YEAR ENDING 28TH FEBRUARY

	1986		1987		1988	
	£000	£000	£000	£000	£000	£000
Fixed assets						
Test lab.	-		52.5		45.0	
Tools, equip.	4.0		21.4		17.9	
Office equip.	3.0		3.5		11.5	
Vehicles	6.0		18.0		16.2	
Demonstrators	-		-		35.0	
		13.0		95.4		125.6
Current assets						
Stocks	10.0		27.0		52.4	
Debtors	2.5		4.0		80.0	
Cash/bank	94.0		88.6		158.0	
		106.5		119.6		290.4
Current liabilities						
Creditors	86.5		89.0		114.0	
Taxation	3.0		-		22.0	
		89.5		89.0		136.0
Net current assets		17.0		30.6		154.4
Capital employed		30.0		126.0		280.0
Financed by:						
Share capital		1.0		1.0		1.0
Profit and loss acct.		29.0		25.0		79.0
Loan capital		-		100.0		200.0
		30.0		126.0		280.0

STATEMENT OF SOURCE AND APPLICATION OF FUNDS FOR YEAR ENDING 28TH FEBRUARY.

	1987		1988	
	£000	£000	£000	£000
Sources				
Profit	(4.0)		54.0	
Depreciation	17.6		21.8	
		13.6		75.8
Loans	100.0		150.0	
		113.6		225.8
Applications				
Fixed assets	100.0		52.0	
Taxation	3.0		-	
Loan repayment	-		50.0	
Increase in stock	17.0		25.4	
Increase in debtors	1.5		76.0	
	18.5		101.4	
Increase in creditors	(2.5)		(47.0)	
		16.0		54.4
		119.0		156.4
Cash movement		(5.4)		69.4

CASH FLOW SUMMARY, YEAR ENDING 28TH FEBRUARY 1987

	MAR £000	APR £000	MAY £000	JUN £000	JUL £000	AUG £000	SEP £000	OCT £000	NOV £000	DEC £000	JAN £000	FEB £000	TOTAL £000
SALES INCOME													
VB 200		36.1				36.1				36.1			108.3
VB 400	49.4				49.4				49.4				148.2
VB APS 100			94.0			94.0			94.0			94.0	376.0
VB PPS			66.8				66.8				66.8		200.4
HPLC		14.0		14.0		14.0		14.0		14.0		14.0	84.0
Consumables	0.9	1.3	1.4	1.9	1.3	1.6	1.9	1.7	2.1	2.2	2.6	2.7	21.6
LOAN CAPITAL		100.0											100.0
TOTAL	50.2	151.4	162.2	15.9	50.7	145.7	68.7	15.7	145.5	52.3	69.4	110.7	1038.5
PURCHASE OF MATERIALS													
VB 200			28.7				28.7				28.7		86.1
VB 400	38.4	38.4				38.4				38.4			153.6
VB APS 100	73.9			73.9			73.9			73.9			295.6
VB PPS				58.2				58.2				58.2	174.6
HPLC	21.0		10.5		10.5		10.5		10.5		10.5		73.5
Consumables			2.8			3.0			3.7			4.6	14.1
TOTAL	133.3	38.4	42.0	132.1	10.5	41.4	113.1	58.2	14.2	112.3	39.2	62.8	797.5
EXPENSES													
Payroll	5.0	5.1	5.1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	69.2
Overheads	2.5	3.2	6.0	1.6	9.8	3.0	2.1	4.6	6.2	5.5	12.4	17.3	74.2
Capital items			45.0	20.0		20.0	15.0						100.0
Taxation				3.0									3.0
TOTAL	7.5	8.3	56.1	30.6	15.8	29.0	23.1	10.6	12.2	11.5	18.4	23.3	246.4
Net cash in/out	(90.5)	104.7	64.1	(146.8)	24.4	75.3	(67.5)	(53.1)	119.6	(75.1)	11.8	24.6	(5.4)
Cash at start	94.0	3.5	108.2	172.3	25.5	49.9	125.2	57.7	4.6	123.7	52.2	64.0	94.0
Cash at close	3.5	108.2	172.3	25.5	49.9	125.2	57.7	4.6	123.7	52.2	64.0	88.6	88.6

CASH FLOW SUMMARY, YEAR ENDING 28TH FEBRUARY 1988

	MAR £000	APR £000	MAY £000	JUN £000	JUL £000	AUG £000	SEP £000	OCT £000	NOV £000	DEC £000	JAN £000	FEB £000	TOTAL £000
SALES INCOME													
VB 200		36.1				36.1				36.1			108.3
VB 400	49.4				49.4				49.4				148.2
VB APS 100			94.0			94.0			94.0			94.0	376.0
VB PPS			66.8				66.8				66.8		200.4
HPLC		14.0		14.0		14.0		14.0		14.0	14.0	14.0	98.0
Consumables	2.4	2.2	2.4	2.1	2.2	2.2	2.2	2.2	2.4	2.5	2.6	2.7	28.1
DNA Sequencer			35.0	70.0	35.0		70.0	70.0	105.0	105.0	140.0	140.0	770.0
LOAN CAPITAL	60.0			90.0									150.0
TOTAL	111.8	52.3	198.2	176.1	86.6	146.3	139.0	86.2	250.8	157.6	223.4	250.7	1879.0
PURCHASE OF MATERIALS													
VB 200			28.7				28.7				28.7		86.1
VB 400		38.4				38.4				38.4			115.2
VB APS 100	73.9			73.9			73.9			73.9			295.6
VB PPS				58.2				58.2				58.2	174.6
HPLC	10.5		10.5		10.5		10.5		10.5		10.5	10.5	73.5
Consumables			3.0			3.0			3.0			4.1	13.1
DNA Sequencer	30.0	30.0	30.0	30.0	30.0	30.0	45.0	45.0	45.0	30.0	45.0	45.0	435.0
TOTAL	114.4	68.4	72.2	162.1	40.5	71.4	158.1	103.2	58.5	142.3	84.2	117.8	1193.1
EXPENSES													
Payroll	11.4	12.0	12.0	12.0	13.1	14.1	16.8	17.8	19.2	19.2	19.5	19.5	186.6
Overheads	2.1	3.1	6.4	1.7	11.2	4.2	1.4	3.6	5.2	1.6	11.9	5.9	58.3
Interest charges				10.0					20.0			24.0	54.0
Royalties		8.0	8.0	8.0	8.0	8.0	8.0	12.0	12.0	12.0	8.0	12.0	104.0
Commission				15.4	7.7		7.7	15.4	15.4	23.1	30.8	23.1	138.6
CIF charges			0.6	0.8	0.3		0.9	0.6	1.2	0.9	1.2	1.5	8.0
Capital items		7.0	5.0	5.0									17.0
Loan repayment												50.0	50.0
TOTAL	13.5	30.1	32.0	52.9	40.3	26.3	34.8	49.4	73.0	56.8	71.4	136.0	616.5
Net cash in/out	(16.1)	(46.2)	94.0	(38.9)	5.8	48.6	(53.9)	(66.4)	119.3	(41.5)	67.8	(3.1)	69.4
Cash at start	88.6	72.5	26.3	120.3	81.4	87.2	135.8	81.9	15.5	134.8	93.3	161.1	88.6
Cash at close	72.5	26.3	120.3	81.4	87.2	135.8	81.9	15.5	134.8	93.3	161.1	158.0	158.0

Appendix 1.

a) DNA sequencing procedure.

DNA is the genetic material of all but the very simplest forms of life, and in essence is a form of coded information which determines the characteristics of living organisms. Deciphering this code is of fundemental importance to the development of our understanding of biotechnology, and ultimately our success in realising the potential biotechnology offers.

The code itself is relatively simple, being made up of four subunits (nucleotides) called adenine (A), thymine (T), cytosine (C) and guanine (G). These link together to form strands which may be many millions of nucleotides long. The structure formed looks rather like a spiral ladder, with A always pairing with T, and C with G, ie:

ATCAGTACCGT
TAGTCATGGCA

A reliable method for working out DNA sequences was developed in 1977 by Dr Fred Sanger at Cambridge University, and it is this method which is automated in the Brookfield machine. In order to understand the operation of the machine, the procedure is described.

A complimentary copy of a single strand of DNA can be made using an enzyme called DNA polymerase. Dr Sanger developed a method whereby the sequence of this copy strand can be worked out, and from this the sequence of the original strand deduced.

The method relies on the fact that the enzyme always commences its copying activity at specific points on the DNA known as initiation sites. We can analyse the sequence of the copy by adding specially altered nucleotides which prevent the enzyme from carrying on with its copying activity.

By doing this, we eventually end up with a series of pieces of DNA of differing length, eg.

Original strand	ATCAGT	* = initiation site
Copy fragments	*T	
	*TA	N = normal nucleotide
	*TAG	
	*TAGT	N = altered nucleotide
	*TAGTC, etc.,	

By identifying the blocking nucleotide, and where it occurs in relation to the initiation site, the sequence of the DNA strand can be deduced.

b) The machine.

The DNA sequencer consists of an automated reagent dispenser which distributes the DNA strands under analysis, together with the normal and modified nucleotides and other reagents, onto a mixing template. The time taken for one reaction cycle, ie. from dispensing the reagents to completion of strand copying, takes approximately 40 minutes.

The newly synthesised pieces of DNA are seperated out using a technique called gel electrophoresis, a technique which gives high resolution of the different pieces of DNA according to their length.

The resulting pieces are examined by an analyser and the nucleotide which terminates the chain , together with its position in relation to the initiation site, is identified. This information is collated by computer, which then displays the final sequence of the DNA segment.

Figure 1 is a diagramatic representation of the DNA sequencer.

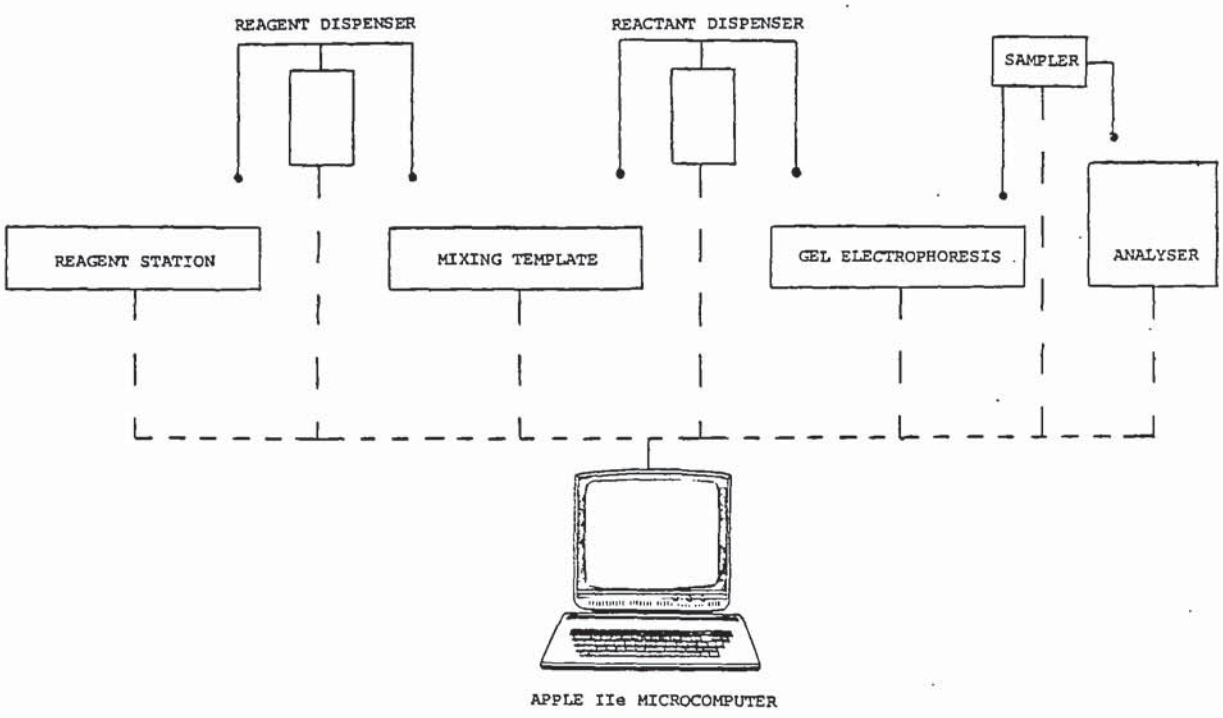


Figure 1. The Southampton Polytechnic/Brookfield Instruments DNA Sequencer

The computer used, for the analysis and controlling the machines functions, is an Apple IIe microcomputer.

The reagent/reactant dispensers are Biolab ME4 Microdispensers

The analyser used is based on an Ambex 202b system.

Appendix 2.

DETAILS OF LICENSING ARRANGEMENTS WITH SOUTHAMPTON POLYTECHNIC

The following summarises arrangements have been concluded with the Polytechnic authorities concerning the manufacture of the DNA sequencer. The legal documents concerning this arrangement will be made available as required at a later date.

1. Southampton Polytechnic retain all patent rights for the machine.

2. A cash payment of £30 000 with respect to obtaining exclusive manufacturing rights was paid to the Polytechnic in November 1985. This agreement is re-negotiable after five years. Within this period, any improvements to the machine made by the Polytechnic, which arise as a result of experience of the machine in use, and which do not constitute a complete redesign of the DNA sequencer, will be made available to the company. The design and construction of a 'second generation' machine will be persued subject to the success of the present collaboration.

3. A royalty of £4 000 per machine manufactured is payable to the Polytechnic authorities, until sales exceed £4.5m annually. Thereafter, a royalty of 17% of sale price will be payable.

4. The Department of Instrumentation and Automation will act as technical consultants and advisors as neccessary, and will co-operate in any development work initiated by the company that may be required as a result of field operation of the machine.

Appendix 3. CURRICULUM VITAE.

Name	James Martin APPLEBY
Date of birth	June 5th 1940
Age	45
Nationality	British
Marital Status	Married, three children

Education

1958-1961	University of Manchester	BSc 1st class honours, biochemistry
1961-1964	University of Manchester	PhD research. Thesis title, 'Studies on the replication of deoxyribo-nucleic acid'

Employment history

1983-date	Director, Brookfield Instruments Limited.	Responsibilities as co-director are: (i) for technical support of products, including training and after-sales consulatation and servicing, (ii) implementation of manufacturing and assembly procedures (iii) new product development
1979-82	Vanguard Biotechnics Inc.	Development of automation procedures for DNA oligonucleotide synthesis, in association with Syracuse University. Responsible for preparation of research protocols, budgeting, liason, and supervision of research staff.
1974-79	Merck Sharpe and Dohme Inc. USA.	Molecular biology research division. Research into the use of recombinant DNA techniques for the production of cloned gene fragments. Management of a group of 10 graduate and doctoral workers.
1971-73	Merck Sharpe and Dohme Ltd.	Anti-virals division, investigating the molecular feasibility of anti-viral compounds.
1967-71	ICI Pharmaceuticals Ltd.	Investigation of mechanisms for inhibition of viral DNA replication, as a basis for the development of chemothrapeutic anti-viral compounds.
1964-66	University of Liverpool	Post-doctoral research, investigating mechanisms of mammalian DNA synthesis.

Name	Robert LYE
Date of birth	19th September 1948
Age	37
Nationality	British
Marital Status	Married, no children

Education

1966-1969	University of Sussex	BSc 2:ii honours, chemistry
1979-80	Lowell Johnston Business School, Washington.	MBA, Marketing. Company sponsored executive development programme.

Employment history

1983-date	Director, Brookfield Instruments Limited.	Responsibilities as co-director are: (i) for the company's sales and marketing operations, (ii) company secretary
1981-82	Vanguard Biotechnics Inc.	Deputy director with joint responsibility for development of marketing strategy for the Vanguard product range in the US and Europe. Responsible to the director of marketing, and in charge of a small marketing department.
1976-79	Merck Sharpe and Dohme Ltd.	Entered as marketing assistant, and after two years was product manager, pharmaceuticals, responsible for marketing products with annual sales in excess of $10m.
1974-76	BRM Instruments Ltd.	Area sales manager, southern England. Responsible for 4 staff, together with office based marketing.
1971-74	BRM Instruments Ltd.	Technical sales representative, selling a range of equipment to hospital, industrial and educational laboratories.
1969-71	Beechams Pharmaceuticals	Medical representative.

TISSUE REPRODUCTIONS INC.

INTRODUCTION.

Begun three years ago, Tissue Reproductions Inc. now offers surgical physicians a substitute product for use in surgeries which involve replacing missing hard tissue such as cartilage and bone. TRI has developed a process whereby a small number of cells taken from a patient's body can be produced outside the body in the laboratory and grown into a tissue of suitable size for implantation in the patient where needed. The surgeon merely provides the laboratory with a small number of cartilage cells taken from behind the patients ear. The laboratory pick up the cells, grows an inch square of cartilage from these cells, and then returns the cartilage square to the surgeon for implantation.

At this point in time, TRI grows one type of cartilage - elastic cartilage. This type of cartilage is used primarily in surgeries which involve areas of the body which will not experience excessive and continuous physical abuse. Examples of appropriate surgeries are those which involve facial repairs such as of the chin, cheek area, skull, jawbone or nose.

TRI maintains an intensive research and development program which undertakes research in the reproduction of other body tissues. Current work involves further refinement of our existing product, elastic cartilage. Within the next two years, we anticipate that TRI will offer preformed cartilage in the basic desired shapes as well as custom made forms for such features as nose and ears. Extensive research is also being done with other types of cartilage cells, as well as with cells from bones, muscles, nerves and special body organs.

In order to carry out our plans in a timely manner, TRI will need $600 000 (£430 000) in additional capital over the next two years. In addition, another $350 000 (£250 000) is to be placed on call should it be neccessary. Dilution arrangements are to be negotiated. This proposal maps the route TRI intends to take in its business activities over the next two years under the assumption that additional financing is obtained.

The following subjects are covered in this document:

- a brief description of the current product and company operations
- a brief description of the management team
- a statement of objectives and goals
- a statement of the assumptions used in the design of this business plan
- financial statements and projections
- a summary of the capital needs and the intended plan for using additional capital
- an appendix containing resumes of principles.

CONTENTS

HISTORY OF TRI

Three years ago, TRI was founded by Dr. Smith and Dr. Jones. Initially, TRI operated out of Dr. Smith's medical offices with a small support staff consisting of a secretary, a laboratory technician, and a research scientist. During this three year period, the primary focus has been to obtain FDA approval for our product, cloned elastic cartilage.

In the first year, the FDA approval process was begun. Legal counsel was hired to handle the legal paperwork required by the FDA. The small research staff was hired to continue work on tissue reproduction which is to lead eventually to our next product. The two principles, Dr. Smith and Dr. Jones, also participated in this research phase. Also during this first year, leading plastic surgeons in the nation were supplied with units of cloned elastic cartilage free of charge which they agreed to use in their surgeries. They then reported their findings in national journals and at medical conventions.

In operating out of Dr. Smiths medical offices, TRI was able to share much of Dr. Smiths laboratory equipment. To support the research, TRI obtained a foundation grant which covered the cost of staff salaries, some laboratory equipment and research supplies. The obligations under this grant were to supply a technical report to the foundation at the completion of the grant. The grant was provided to fund basic research in the area of tissues reproduction.

During the second year of operation, the FDA approval process continued to be the primary focus of TRI; however, during this year, an advertising campaign was begun which involved journal and direct mail media. Because the FDA process appeared to be moving ahead toward completion in the third year, it was felt that advertising at this stage would help build interest in the product sufficient to guarantee some sales as soon as the FDA process was completed in the following year. In addition to the journal and mail campaigns, promotional giveaways of cloned elastic cartilage units were continued to be sent to leading surgeons across the nation. Again, it was anticipated that these surgeons would publish their findings.

Also during this second year, the foundation extended its grant from the first year. Again, the funds covered the research staff salaries and supplies. No new equipment was acquired in this year. TRI continued to use the laboratory equipment in Dr. Smith's laboratory as well as the medical facilities.

Now in its third year of operation and with the FDA approval process nearing its end, TRI is considering moving to medical facilities of its own. Dr. Bolt joined the staff in mid year as Vice President of Research. He has also become a major stockholder in the corporation by contributing $75 000 (£53 571) in equity capital.

The advertising budget has been increased 100% to cover both displays at the major conventions in addition to journal and mail advertising campaigns. By the year's end, the FDA approval process will have been completed. TRI will be ready at that point in time to begin commercial production of elastic

cartilage tissue. Due to the time frame involved in growing the tissue, (two weeks), all sales orders must be made in advance and surgeries scheduled to account for this production period. Again, promotional giveaways of cartilage were continued to create further interest in the product.

The foundation grant this year continues to cover research salaries and supplies. It is anticipated that this is the last year that this grant will be available to TRI. TRI expects to cover its research and development costs through sales in the near future.

During this first three year period, TRI has operated on funds obtained from the initial capitalisation, additional equity investments in years two and three, and from the foundation grants. Initially, TRI was capitalised with $135 260 (£96 614) which was contributed by Dr. Smith and Dr. Jones on a 75% to 25% basis. In year two, another $80 260 (£57 329) was contributed on a 75% to 25% basis bringing the total capitalisation to $215 520 (£153 943). In year three, under the same ratio, the principals again contributed a total of $130 260 (£90 043), bringing the total capitalisation to $345 780. The third principal was brought into TRI at mid year when he contributed $75 000 (£53 571) in equity. Total capitalisation at year end will be $420 780 (£420 780).

Over the three year period, grant funds have totalled $115 000. These funds have been used in persuing the research efforts of the company. There have been no repayment obligations to the foundation, only the obligation to produce a technical document reporting the findings of the research.

Details of the financial aspect of the company since its inception are contained in the section on financial projections.

THE PRODUCT AND OPERATIONS

Currently, TRI offers one product line which is the production of elastic cartilage. This cartilage is taken from the patient in cellular form and then grown in the laboratory to a size sufficient for surgical implant. Technically, there are several advantages to using this form of reproduced tissues:

1) Decreased possibility of extrusion - this means that over the lifetime of the implant, it is highly unlikely that the implanted tissue will change form and protrude from under the skin where it was placed surgically. This reproduced tissue will remain in place without causing changes in the adjoining bone tissues.

2) Decreased possibility of infection - because it is the patients own tissue reproduced outside the body, the possibility for infection and ultimately rejection of the implant is very small.

3) Size of implant is limitless - not being dependant upon existing tissues which could be moved (such as ribs), and used to replace missing tissue permits greater flexibility in the surgical implant process. Because supplies of existing bodily substitutes are limited, surgical implants in this form of replacement tissue are also limited. Laboratory reproduced tissue eliminates the scarcity problem.

4) Reduces need for multiple major surgical operations - the gathering of cells and laboratory-growing them into tissue eliminates the need for a major operation to remove suitable existing tissue and then another major operation to implant that tissue. With laboratory reproduced tissue, only the implant surgery becomes neccessary.

The essential materials for reproducing this tissue are obtained from two major biological supply houses which have offices in Los Angeles. At the moment, we are paying $115 (£82) in supplies to produce one unit of tissue. We expect that with increased volume this figure will drop.

Capital equipment for manufacturing the cartilage involves both basic laboratory equipment and special machines for reproducing tissue. The basic lab equipment costs us approximately $15 000 (£19 714) and has a useful life of five years. The cell machines, on the other hand, cost us $5 000 (£3571) each and can have a useful life of from 3 to 5 years. Each machine can produce one unit of cartilage tissue every two weeks. Due to the unique nature of the cell machines, we do not expect to be able to receive much of a cost reduction based on quantity buying. It is likely, however, that we will be able to develop our own machines in the next few years. Currently, we get our machines from a company in Massachusetts which requires at least six months lead time from order to delivery. Though it is possible to reproduce cells without this device, the cell reproduction machine reduces the total square footage of space by 100 fold and reduces the technician time significantly.

The production process itself takes two weeks from the time of delivery of the cells to the laboratory. Setting up of the machine with fresh cells takes the technician half a day. From that point on until the two weeks are through, it takes an assistant half an hour a day to service the process. Labor costs for this part of the production process, therefore, are minimal and diminishing with increasing numbers of unit production.

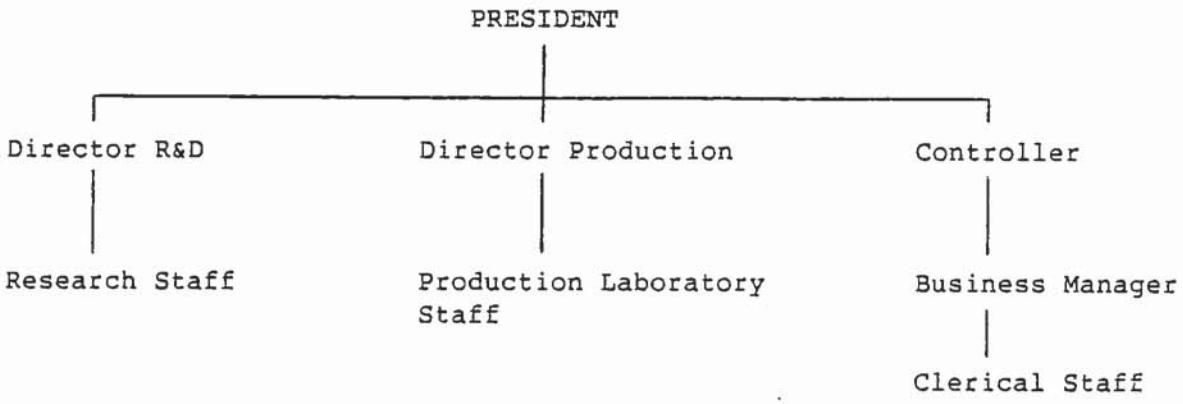
The entire process from pickup of the cells to delivery of the grown tissue takes approximately two and a half weeks. Our laboratory technician arrives at the doctor's office and collects the appropriate cells from the patient. Upon return to the laboratory, the cells are placed in the cell reproduction machine and grown for two weeks. At the end of the two weeks, the delivery van returns the cartilage unit to the doctor's office in sterile form. At delivery, the doctor pays for the cartilage unit. TRI guarantees delivery of sterile cartilage tissue which is the same tissue as was grown from the patient's cartilage cells. Any problems incurred during surgery which are of a surgical nature are the doctor's responsibility.

In addition to the production of the cartilage units for sale, TRI maintains an extensive research laboratory which both monitors the quality control aspect of the production laboratory as well as conducting research on production of forms of tissue. Currently, work is being done on other forms of cartilage tissue. It is expected that joint cartilage will be ready for submittal to the FDA for approval within the next two years. Long term research is being done on vital organ reproduction primarily involving the pancreas. Due to the importance of this research and development function to the overall success of the corporation, a sizeable portion of the budget is devoted to this function. Capital equipment alone is costly and expensive. Initially, $50 000 (£35 714) must be invested in start-up capital equipment. As the projects become more specialised, additional equipment will be neccessary. TRI plans to design equipment for its purposes, but the costs even in this approach will be extensive.

THE MANAGEMENT TEAM

TRI feels that it is important to have a management team which represents both the medical technology with which it is associated as well as the business arena in which it functions. The company was founded by two medical doctors who are plastic surgeons by training. The President and lead principal has had prior business experience as the founder of a successful surgical supply company in southern California. Both doctors had done primary research in the tissue reproduction technology prior to starting the corporation. Both of them have continued in the basic research upon formation of the corporation. By the third year it became obvious that an additional member was needed who represented the professional research end of the corporation. The doctor who joined the team has both an M.D. and a Ph.D. in cellular biology. Resumes of these three principles are contained in the appendix to the business proposal.

The following organisational chart illustrates the proposed structure which the corporation will take upon receipt of the additional capital financing:



TRI believes in paying competitive salaries to its employees as a means of acquiring and keeping the best available personnel. A company profit sharing scheme is being proposed for the time when net profits are realised. At this time, employees receive medical benefits, group life insurance, and a group pension plan as additional compensation. During the first three years of operation, the principal officers have not received any form of renumeration from the corporation except for expenses. Again, it is anticipated that they will receive a salary within the next year.

Currently, interviews are being conducted for the hiring of a business manager and the additional laboratory and clerical staff which TRI anticipates will be neccessary within the year. The business manager will ideally have a masters degree in business and a proven track record. All laboratory staff will have had prior experience as well as appropriate academic training.

For the past three years, we have had a part time controller who has handled all our financial and accounting matters. We are negotiating with her now to take a full time position with TRI. We intend to give her stock in the corporation in addition to a salary and other benefits. She has had experience as controller with a similar organisation. While her responsibilities will be similar to those of a financial Vice President, we feel that she is not quite ready for that position. She does however have the neccessary training and background to handle our needs at this point and should be a valuable asset to us in the long run as she grows with the corporation.

OBJECTIVES AND GOALS

Within the next few years, TRI expects to be the largest biological supply laboratory of replacement tissue in the nation. It is anticipated that over time, TRI will be in a position to acquire a large percentage of the cell and culture media distribution business as well.

In order to attain the objective of being the largest biological supply laboratory in the nation, TRI has established several operating goals:

1) Research and development efforts.

This function will involve the largest capital commitment within the corporation. Primary efforts will be divided into two areas:

1) The development of new, more efficient methods for reproducing tissues that we currently grow for the commercial market;

2) The development of methods for reproducing all forms of body tissue which currently cannot or have not been reproduced successfully. The operating goal of this research and development effort is to have a new product in the FDA approval process every two years. With this goal, it will be possible to have new products entering the market place at least every two years within the next three years. Corporate profits in the early years, then, will be put into this effort rather than in large dividend payouts to stockholders.

2) Marketing efforts.

The basic strategy will be to advertise new products heavily in the major journals as soon as they begin the FDA process. It is anticipated that between $50 000 and $75 000 (£35 741-£53 571) will be spent in the years that this process is going on. During this period, sample units of the tissue will be grown and given to leading plastic surgeons to use with the understanding that they publish an article detailing their results. As the FDA process nears completion, a massive campaign at the major medical conventions will be undertaken to promote the new product. By the time the product comes to the market place, sufficient interest will have been developed that it can be expected to be profitable within the first year that it is on the commercial market.

3) Educational efforts.

TRI intends to spend time with each of its leading plastic surgeons, educating them in the use of this new product. In addition to educating these surgeons, TRI will have a regular program established whereby it conducts seminars at medical schools and large hospitals for their staff members and physicians. This educational process will lead to increased demand for future tissue replacement products.

In general, then, the operating goals will be to take all profits from sales and reinvest them in research and development efforts and in new and continued promotional efforts of existing and future product lines. Dividend payouts in these early years will be small if paid at all. In order to promote interest in this form of replacement tissue , extensive educational programs will be undertaken in addition to the advertising and promotional campaigns.

At such point that the profits exceed the neccessary expenses for research and development, a program of actively investigating acquisition potentials will be started. It is the intent of TRI to grow through both internal methods as well as through acquisition. Likely candidates for acquisition should be in a field directly related to tissue reproduction. These candidates include existing biological supply houses, equipment manufacturers in the field of cellular reproduction, and basic research laboratories with large grant support.

ASSUMPTIONS OF THE BUSINESS PLAN

The background assumptions of this business plan fall into three basic categories:

1) Financial
2) Market analysis
3) Market strategy

Financial

In developing this plan, it has been assumed that $600 000 (£430 000) in additional capital has been raised from an outside capital source. It it expected that this sum will be split between equity and convertible debentures with the predominant amount being in equity. It is assumed also that this sum will be used wisely and result in a financially viable corporation. By the next round of financing (approximately year six), it will be reasonable to expect the additional monies can be made available on an equity basis as needed. We would like an additional $350 000 (£250 000) to be on call. The financial projections shown here have assumed that the entire $600 000 was raised on an equity basis.

Market analysis

Approximately 20 000 operations involving the elastic cartilage we produce are performed a year in the USA. Of these, approximately 2 000 are being done in the Los Angeles and Orange county areas. A large proportion of the country's plastic and related surgeons reside in the southern California area.

Currently, alloplastic materials (synthetic plastics) such as silastic and polymers which are surrounded by natural tissue, as well as heterotopic autografts (replacement of tissue with tissue taken from elsewhere in the patients body) using such parts as ribs, ears and ileac creats (hips) are the standard substances used to replace missing hard tissue. Plastics tend to either extrude after time or to waste away the bone to which they are connected. Infiltrated polymers are difficult to remove or remodel. Living tissues such as ears, hips and ribs do not extrude; however, there is increased morbidity.

Essentially, the competition is divided between two groups of proponents; surgeons who use alloplastic materials, and surgeons who use autografts. Of the alloplastic materials, protoplast (a polymer surrounded by tissue), silastic (a solid plastic which is not surrounded by tissue) and acrylic (a medical grade acrylic) are the three primary favorites with most surgeons who use alloplastic. All of these are available through commercial companies.

Another school of surgeons prefers the autograft technique. Obviously, this has its limitations since there are a finite number of parts within the human body which are substitutable for elastic cartilage, and a percentage of these will undergo resorption (will absorb the surrounding materials and thus change form).

At this point, no other firm is producing replacement tissue as we propose to do. We are unaware of any other firm even considering such an approach. We can anticipate that the biological supply houses which provide the cell cultures and media might be interested in starting a business such as ours, but to date this has not occured. We can only surmise that they have been unwilling to do the testing and promotion which is neccessary in order to get such a product line off the ground. Also, they may not be willing to undertake the FDA in terms of the approval process. Though this is an alternative we have chosen to take in order to protect our product and corporation from immidiate direct competition, others may wish to see the outcome of the FDA approval before investing in cell production. Because of the obvious desirable features of our product such as it being the individuals own tissue, we feel ultimately that it will replace all known alternative forms of tissue replacement.

Marketing strategy

Because no part of this tissue reproduction process is patentable, we have chosen to seek FDA approval as a means of creating lead time for ourslves in the marketplace over our competition. The entire approval process takes approximately three years. It is our intent to put all of our products through this FDA test as a technique of creating lead time. During the time that the FDA is reviewing the product, we will conduct extensive advertising and marketing campaigns to create interest in our product. Also, we will conduct an intensive physician training program at local hospitals and at the appropriate scientific meetings where new technologies generally are introduced. Leading physicians in plastic surgery will be offered free cartilage units to try. They then must continue to report on their results independant of our studies at these scientific meetings. Generally, we expect a two year turn around from the time a doctor uses our product to the time he reports his finding to a scientific community. Because this is a slow process, we anticipate that we also will have to take on a few doctors in a formal education process, though this will become more viable later as we become recognised nationally.

Note that our intent in acquiring FDA approval is to get a jump on the competition. While we advertise during the approval period, we create demand and interest in our product. Meanwhile, competition will have to go through the same approval process if they intend to enter the market place, assuming, of course, that their production process is slightly different from ours. This will take them the same amount of time that it takes us, but they will not have had the advantage of being the first and the most well known in the area of cell reproduction. It should also be noted that considerable knowledge and experience has been gained by the TRI staff in the development of the reproduction process for elastic cartilage. We feel that, in fact, a primary barrier to entry in this field will be the lack of experience in the technology by others. Of course, this experience can and will be obtained so we must move quickly if we are to keep our lead.

We have considered the possibility of having detailers peddle our product much like it is done in the drug industry. At this point, we feel that the cost far outweighs the potential benefits from this approach. We feel that the medical community will respond more rapidly and favorably to reports of their peers than to reports of professional salesmen.

In pricing our tissue reproductions, we have found that in order to get into the marketplace, we have to be competitive with the alternative substitutes. We therefore have priced the single units of cartilage at $600 (£429) apiece. Each piece is approximately one inch square. We feel that we can maintain this pricing schedule, assuming that we can anticipate a 60% penetration of the California plastic and related surgery market; and assuming that each surgeon does approximately ten cases a year where this type of cartilage would be an appropriate substitute. Due to the intangible benefits of this product, such as its unique nature of being the individuals own cartilage grown from his own cells, we feel there is some flexibility on price. While other substitutes may be a few dollars less, the obvious quality of our product makes it significantly more appealing. We feel that the price difference is negligable and is covered by insurance anyway. Perhaps, costs will be lessened in the long run considering the benefits of this cartilage.

Because the laboratory's responsibility is to produce a healthy unit of living tissue and not to guarantee that an individual's operation will be successful with the use of this tissue, we feel that payment for the tissue should be made upon delivery. The number of times any one doctor will use our services in the course of a year is limited and depends solely on the laws of nature and his marketing ability. We feel, therefore, that receiving payment as the cartilage is delivered should not affect the doctors cash flow significantly, but delayed payments would affect our cash flow. Also, we do not wish to have our payment delayed should the doctor be unsuccessful in his surgery. We guarantee the delivery of healthy tissue, not the associated aspects of the surgery.

All selling of the tissue would be done directly with the surgeon involved. We, the laboratory, will meet the patient in the doctor's office, where we will supervise the taking of the appropriate cells from the patient's body. We will then return the cells to our laboratory where they will be grown into the appropriate tissue size. Next, we will deliver the tissue to the surgeons office. The entire process should take two weeks, assuming that the cells can be reproduced. Should there be a failure in the surgery, the process of retrieving the cells, growing the tissue, and delivering the reproduced tissue would have to be repeated which would involve another two weeks. Any servicing of the tissue once it is implanted would be the responsibility of the surgeon and not of our laboratory.

At the moment, we only have one laboratory available to perform this reproduction service. While it is possible to service other parts of the US from this location, it is reasonable to expect that we will have toestablish other laboratories within the near future, if we expect to remain competitive with other suppliers of the substitute products.

The assumptions in summary then are as follows:

1) $600 000 additional capital is acquired through a venture capital source this year; an additional $350 000 will be made available in year six.

2) The entire market consists of 20 000 operations a year nationally for the elastic cartilage units we are currently reproducing.

3) Current competition is divided between proponents of alloplastic materials for implants and of autografts which involve using the individual's own substitutable tissue.

4) The use of FDA approval process will provide us with a three year lead on the competition which will act as a patent right in the short run.

5) We are responsible only for the delivery of healthy, sterile, tissue, and are not liable for any part of the surgical procedure.

6) Our price will remain competitive on the high side since our product has obvious aesthetic value which cannot be measured in dollars. Insurance policies will cover the primary costs for the individual.

FINANCIAL PROJECTIONS

Income and balance sheet statements for years one and two show actual figures. The neccessary capital to get the corporation going in these years was put up on a 75% to 25% ratio by Drs. Smith and Jones in the amount of $135 260 (£96 614) in year one and $80 260 (£57 329) additional in year two. In these first two years, the product was undergoing FDA approval and therefore no sales could be made of the cartilage. Instead, promotional units were grown and distributed to surgeons across the country. Two units per month (24 per year) were given away. An advertising campaign was begun in the major journals in the second year. This campaign amounted to $50 000 (£35 714) in expenses. Over the two year period, stockholders' equity was reduced from total capital stock of $215 520 (£153 943) and $104 500 (£74 643). Foundation grants in the amounts of $45 000 (£32 413) and then $35 000 (£25 000) funded most of the research during this period.

In year three, an additional stockholder joined the corporation bringing with him an additional $75 000 (£53 571) in capital for the corporation. The income and balance sheet statements for year three are estimated since the year is not completed. Again, in year three, no sales can be made of the product since the FDA approval process will not be completed until year end. Again, 24 units of cartilage were given away as promotional items to leading surgeons. It is understood that these doctors will publish their findings in leading journals and at scientific meetings. Advertising was stepped up this year because of planned emergence of the product on the commercial market at the begining of the following year (year 4). A booth was set up at the national scientific meeting to display the product and its advantages. The principles of the corporation gave lectures at that meeting on the product and talked to several leading surgeons. An extensive campaign was conducted in the leading journals to attract interest. We project that by the year end the stock holders equity will have been reduced to $179 000 (£127 857) from the original $420 780 (£300 557).

Year 4 has been projected on a quarterly basis. We feel that this will be the most critical year in our history. Its success ultimately is dependant upon receiving enough capital in order to hit the market place rapidly and at full capacity. Demand will have been created already. It should merely be a matter of our ability to meet that demand. Plans for meeting that demand include renting facilities of adequate size to accomodate the full research department as well as the production department. We are committed to renting improved warehouse space on a long term lease in Cerritos, California. The location is ideal in terms of major traffic arteries. In addition to the rent, we will be making leasehold improvements in the amount of $20 000 (£14 286). Primarily this will involve laboratory improvements since the front offices are already finished.

Sales already have been made for the first three months of next year (January - 50 units, February - 80 units, March - 85 units). We have projected that the sales for the rest of the year will be as follows: April - 90 units, May - 95 units, June - 110 units, July - 110 units, August - 110 units, September - 85 units, October - 85 units, November - 65 units, December - 40 units. All will be priced at $600 (£429) a unit. We expect that surgeries using our product will follow the same seasonal pattern that other plastic sugeries follow using alternative products. In order to meet

these demands, we must have our laboratory fully operational immidiately with basic equipment and cell machines. Because the cell machines take up to 6 months from order to delivery, we have ordered our supply for the year and have made the assumption that they will be made available immidiately. We feel that some of these machines can be used in the research lab until such time as they are required in the production lab. Again, the projections have been made under the assumption that only two cellular units can be made by any one machine in a given month.

One of our highest costs this year will be research development expenses. We feel that this primary function will the one which helps us stay ahead of the industry. All profits initially will be sacrificed for research and development. As can be seen by the projections, this will be a heavy expense in year 4, but it will begin to even out by year 5 and will pay off on the long run. We intend to spend $254 000 (£181 429) in year 4 directly on research and development. We will not seek additional outside grants for this work since we feel we can cover the costs and we wish to maintain our trade secrets. Even with the additional capital requested of $600 000 bringing the total capital invested to $1 020 780 (£729 129), by year end of the fourth year we expect stockholders' equity to be $53 592 (£38 280).

Projections for year five show stockholders' equity during the middle quarters of the year, though not neccessarily in large amounts. We expect that by year six, we again will have another product ready for the market place and through the FDA approval process. At this point, we will need expansion financing. Year end projections show stockholders' equity increasing to $308 793 (£220 566). Year seven projections show year end stockholders equity of $1 455 163 (£1 039 402).

PROFIT AND LOSS ACCOUNT (ye rs 1, 2, 3)
(All figures in US dollars)

	Year 1		Year 2		Year 3	
Sales		0		0		0
Cost of sales		0		0		0
Added value		0		0		0
Other operating income		51 000		41 000		41 000
Gross income		51 000		41 000		41 000
Expenses						
Advertising expenditure	0		50 000		100 000	
Other sales expenditure	10 260		11 260		11 260	
Total		10 260		61 260		111 260
Administration expenses	26 000		25 500		25 500	
Administration salaries	0		0		0	
Total		26 600		25 500		25 500
R&D expenditure	20 000		10 000		10 000	
R&D salaries	25 000		25 000		25 000	
Total		45 000		35 000		35 000
		81 260		121 760		171 760
Operating surplus		(30 260)		(80 760)		(130 760)
Interest		0		0		0
Income taxes		0		0		0
Net income		(30 260)		(80 760)		(130 760)

BALANCE SHEET (years 1, 2, 3)

(All figures in US dollars)

	Year 1		Year 2		Year 3	
Fixed assets		5 000		4 050		13 100
Current assets						
Raw materials	0		0		0	
Work in progress	0		0		0	
Finished goods	0		0		0	
		0		0		0
Bank	100 000		100 450		165 900	
		100 000		100 450		179 000
Current liabilities						
Trade creditors	0		0		0	
		0		0		0
Net current assets		100 000		100 450		179 000
Total assets less current liabilities		100 000		100 450		179 000
Long term liabilities						
Notes payable	0		0		0	
		105 000		104 500		179 000
Represented by:						
Share capital	135 260		215 520		420 780	
Revenue reserves	(30 260)		(111 020)		(241 780)	
		105 000		104 500		179 000

PROFIT AND LOSS ACCOUNT (year 4)
(All figures in US dollars)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Sales	64 500	88 500	91 500	55 500	300 000
Cost of sales	80 652	117 224	125 062	115 692	438 630
Added value	(16 152)	(28 724)	(33 562)	(60 192)	(138 630)
Other operating income	9 800	9 000	8 400	7 000	34 200
Gross income	(6 352)	(19 724)	(25 162)	(53 192)	(104 430)
Expenses					
Advertising expenditure	37 500	37 500	37 500	37 500	
Other sales expenditure	4 300	5 900	6 100	3 700	
Total	41 800	43 400	43 600	41 200	170 000
Administration expenses	28 356	28 354	28 353	28 353	
Administration salaries	16 902	16 900	16 899	16 899	
Total	45 258	45 254	45 252	45 252	181 016
R&D expenditure	12 501	12 501	12 500	12 498	
R&D salaries	51 000	51 000	51 000	51 000	
Total	63 501	63 501	63 500	63 498	254 000
	150 559	152 155	152 352	149 950	605 016
Operating surplus	(156 911)	(171 879)	(177 514)	(203 142)	(709 446)
Interest	(3 990)	(3 990)	(3 990)	(3 992)	(15 962)
Income taxes	0	0	0	0	0
Net income	(160 901)	(175 869)	(181 504)	(207 134)	(725 408)

BALANCE SHEET (year 4)

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Fixed assets		351 177		335 354		321 533		306 716
Current assets								
Raw materials	10 350		12 650		9 775		9 200	
Work in progress	17 111		20 481		20 507		18 318	
Finished goods	17 111		20 481		20 507		18 318	
		44 572		53 612		50 789		45 836
Bank	628 636		450 536		273 490		75 240	
		673 208		504 158		324 279		121 076
Current liabilities								
Trade creditors	10 350		12 650		9 775		9 200	
						9 775		9 200
		10 350		12 650		314 504		111 876
Net current assets		662 858		491 498				
Total assets less current liabilities		1 041 035		826 852		636 037		418 592
Long term liabilities								
Notes payable	395 936		384 622		375 111		365 000	
		618 099		442 230		260 726		53 592
Represented by:								
Share capital	1 020 780		1 020 780		1 020 780		1 020 780	
Revenue reserves	(402 681)		(578 550)		(760 054)		(967 188)	
		618 099		442 230		260 726		52 592

PROFIT AND LOSS ACCOUNT (year 5)
(All figures in US dollars)

		Quarter 1		Quarter 2		Quarter 3		Quarter 4	Total
Sales		183 000		231 500		237 000		165 000	816 000
Cost of sales		63 042		65 342		62 467		61 892	252 743
Added value		119 958		165 658		174 533		103 108	563 257
Other operating income		18 000		20 000		19 000		12 000	69 000
Gross income		137 958		185 658		193 533		115 108	632 257
Expenses									
Advertising expenditure	37 500		37 500		37 500		37 500		
Other sales expenditure	5 490		6 930		7 100		4 950		
Total		42 990		44 430		44 600		42 450	174 470
Administration expenses	28 356		28 356		28 356		28 356		
Administration salaries	16 902		16 902		16 902		16 902		
Total		45 258		45 258		45 258		45 258	181 032
R&D expenditure									
R&D salaries									
Total		63 501		63 501		63 501		63 501	254 004
		151 749		153 189		153 359		151 209	609 506
Operating surplus		(13 791)		32 469		40 017		(36 101)	22 751
Interest		(3 990)		(3 990)		(3 990)		(3 990)	(15 960)
Income taxes		0		(14 240)		(18 092)		0	(32 332)
Net income		(17 781)		14 239		18 092		(40 091)	(25 514)

BALANCE SHEET (year 5)

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Fixed assets		363 199		344 552		325 985		307 418
Current assets								
Raw materials	13 800		16 100		13 225		12 650	
Work in progress	19 630		30 630		19 630		19 630	
Finished goods	19 630		30 630		19 630		19 630	
		53 060		77 360		52 485		51 910
Bank	(5 005)		2 364		57 586		32 625	
		48 055		79 724		100 071		84 535
Current liabilities								
Trade creditors	13 800		16 100		13 225		12 650	
		13 800		16 100		13 225		12 650
Net current assets		34 255		63 624		96 846		71 855
Total assets less current liabilities		397 454		408 176		422 831		379 303
Long term liabilities								
Notes payable	361 643		358 126		354 689		351 252	
		35 811		50 050		68 142		28 051
Represented by:								
Share capital	1 020 780		1 020 780		1 020 780		1 020 780	
Revenue reserves	(984 969)		(970 730)		(952 638)		(992 729)	
		35 811		50 050		68 142		28 051

PROFIT AND LOSS ACCOUNT (year 6)
(All figures in US dollars)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Sales	412 750	542 750	549 250	471 250	1 976 000
Cost of sales	183 585	208 749	219 325	196 444	799 103
Added value	229 165	334 001	338 925	274 806	1 176 897
Other operating income	18 000	20 000	19 000	12 000	69 000
Gross income	247 165	354 001	357 925	286 806	1 254 897
Expenses					
Advertising expenditure	40 000	40 000	40 000	40 000	
Other sales expenditure	4 127	5 427	5 492	4 712	
Total	44 127	45 427	45 492	44 712	179 758
Administration expenses	29 356	29 356	29 356	29 356	
Administration salaries	17 747	17 747	17 747	17 747	
Total	47 103	47 103	47 103	47 103	188 412
R&D expenditure					
R&D salaries					
Total	63 501	63 501	63 501	63 501	254 004
	154 731	156 031	156 096	155 316	622 174
Operating surplus	92 434)	197 970	201 829	131 490	623 723
Interest	(15 567)	(15 567)	(15 567)	(15 567)	(62 268)
Income taxes	(38 434)	(91 187)	(93 131)	(57 961)	(280 713)
Net income	38 433	91 216	93 131	57 962	280 742

BALANCE SHEET (year 6)

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Fixed assets		978 994		946 570		914 146		881 722
Current assets								
Raw materials	31 050		33 350		30 475		29 900	
Work in progress	19 250		18 018		16 630		14 783	
Finished goods	19 250		18 018		16 630		14 783	
		69 550		69 386		63 195		59 466
Bank	(34 714)		58 034		153 549		213 732	
		34 836		127 420		216 744		273 198
Current liabilities								
Trade creditors	31 050		33 350		30 475		29 900	
		31 050		33 350		30 474		29 900
Net current assets		3 786		94 070		186 269		243 298
Total assets less current liabilities		982 780		1 040 640		1 100 415		1 125 020
Long term liabilities								
Notes payable	916 296		882 940		849 584		816 228	
		66 484		157 700		250 831		308 792
Represented by:								
Share capital	1 020 780		1 020 780		1 020 780		1 020 780	
Revenue reserves	(954 296)		(863 080)		(769 949)		(711 988)	
		66 484		157 700		250 831		308 792

PROFIT AND LOSS ACCOUNT (year 7)
(All figures in US dollars)

		Quarter 1		Quarter 2		Quarter 3		Quarter 4	Total
Sales		900 250		1 127 750		1 134 240		1 056 250	4 218 500
Cost of sales		274 841		331 335		332 241		318 609	1 257 026
Added value		625 409		796 415		802 009		737 641	2 961 474
Other operating income		24 000		26 000		25 000		21 000	96 000
Gross income		649 409		822 415		827 009		758 461	3 057 474
Expenses									
Advertising expenditure	50 000		50 000		50 000		50 000		
Other sales expenditure	4 501		5 639		5 671		5 281		
Total		54 501		55 639		55 671		55 281	221 092
Administration expenses	30 824		30 824		30 824		30 824		
Administration salaries	18 634		18 634		18 634		18 634		
Total		49 458		49 458		49 458		49 458	197 832
R&D expenditure									
R&D salaries									
Total		66 676		66 676		66 676		66 676	266 704
		170 635		171 773		171 805		171 415	685 628
Operating surplus		478 774		650 642		655 204		587 226	2 371 856
Interest		(19 776)		(19 776)		(19 776)		(19 776)	(79 104)
Income taxes		(229 499)		(315 433)		(317 714)		(283 725)	(1 146 371)
Net income		229 499		315 433		317 714		283 725	1 146 371

BALANCE SHEET (year 7)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Fixed assets	1 132 047	1 092 372	1 052 697	1 013 022
Current assets				
Raw materials	65 550	67 850	64 975	64 400
Work in progress	29 534	28 041	26 792	25 375
Finished goods	29 534	28 041	26 792	25 375
	124 618	123 932	118 559	115 150
Bank	336 098)	649 386	964 467	1 245 895
	460 716	773 318	1 083 026	1 361 045
Current liabilities				
Trade creditors	65 550	67 850	64 975	64 400
	65 550	67 850	64 975	64 400
Net current assets	395 166	705 468	1 018 051	1 296 645
Total assets less current liabilities	1 527 213	1 797 840	2 070 048	2 309 667
Long term liabilities				
Notes payable	988 922	944 116	899 310	854 504
	538 291	853 724	1 171 438	1 455 163
Represented by:				
Share capital	1 020 780	1 020 780	1 020 780	1 020 780
Revenue reserves	(482 489)	(167 056)	150 658	(434 383)
	538 291	853 924	1 171 438	1 455 163

CURRICULUM VITAE

NAME	Hanes K. Smith	PLACE OF BIRTH	Fresno, California
TITLE	Chief, Plastic Surgery	NATIONALITY	U.S.
DATE OF BIRTH	July 18th, 1942	SEX	Male

EDUCATION

Institution and Location	Degree	Year	Scientific Field
Univ. of California, L.A.	B.Sc.	1963	Microbiology
Univ. of California, L.A.	M.D.	1967	Medicine
Univ. of California, L.A.	Intern	1968	Medicine
Univ. of California, L.A.	Resident	1969	Plastic Surgery
Univ. of California, L.A.	Fellow	1970	Plastic Surgery

HONORS

Distinguished Faculty Award Research	UCLA	1973	Cellular Implants
NIH Postdoctoral Fellowship	NIH	1973	Immunology

MAJOR RESEARCH INTEREST

Cell Cloning (Cartilage and Related Tissues)

RESEARCH SUPPORT

NIH grant for experimental cloning of cartilage cells 1976

AWARDS

Columbia University Ambrose Bierce Award	Cellular Research	1975
Univ. of Chicago, Chaffin Warren Award	Plastic Surgery	1977
Presidential Award for counteracting aging		1977

Professor of Surgery, UCI	1976
Chief of Surgery, Plastic Division, UCLA	1978

PUBLICATIONS

Dr. Smith has published extensively in medical journals. He is author of a standard textbook on plastic surgery techniques. In 1978 he delivered the first conclusive test results for cloned cartilage implants.

BUSINESS EXPERIENCE

Dr. Smith started and continues to oversee the Southern California Surgical Supply Co. which supplies local hospitals with supplies and large machinary (on a rental basis). The corporation was started 5 years ago and now grosses S2 250 000 a year.

CURRICULUM VITAE

NAME	David B. Jones	PLACE OF BIRTH	Guam
TITLE	Chief, Plastic Surgery	NATIONALITY	U.S.
DATE OF BIRTH	June 16th, 1946	SEX	Male

EDUCATION

Institution and Location	Degree	Year	Scientific Field
Princeton Univ. N.J.	B.Sc.	1967	Microbiology
Harvard Univ.	M.D.	1971	Medicine
Deaconess Hospital	Intern	1972	Medicine
Univ. of California, L.A.	Resident	1973	Immunology
Univ. of California, L.A.	Fellow	1975	Plastic Surgery

HONORS

John F. Kennedy Award		1973	Medicine
NIH Postdoctoral Fellowship	NIH	1976	Cell biology

MAJOR RESEARCH INTEREST

Cell Cloning (Cartilage and Related Tissues), Reconstruction

RESEARCH SUPPORT

NIH grant for experimental cloning of cartilage cells 1978

AWARDS

Univ. of California P.M. Dolby Prize	Rhinoplasty	1975
Acadamy of Motion Pictures	Plastic Surgery	1979

Assistant Professor, Cellular Implants 1978

PUBLICATIONS

Dr. Jones has published 14 articles worldwide on the role of cellular implants in rhinoplasty.

BUSINESS EXPERIENCE

Dr. Jones has been retained by the Sunkist Corporation to oversee an investigation into, and possible commercial exploitaion of results from, the connection between prune wrinkling and human skin ageing.

CURRICULUM VITAE

NAME	Natty R. Bolt	PLACE OF BIRTH	New York
TITLE	Chief, R&D, Micro-cells Inc.	NATIONALITY	U.S.
DATE OF BIRTH	October 10th 1942	SEX	Male

EDUCATION

Institution and Location	Degree	Year	Scientific Field
Cornell	B.S.	1965	Biology
John Hopkins	M.D.	1969	Medicine
John Hopkins	Intern-Resident	1968-70	Surgery
Univ. of California, L.A.	PhD	1974	Microcellular structures

BUSINESS EXPERIENCE

Micro-Cells, Inc.	Chief, R&D	1974-present

HONORS

PhD Fundamental Award	UCLA	1973	Cellular Implants

MAJOR RESEARCH INTEREST

Cloning cells

PUBLICATIONS

Dr Bolt has published 25 papers in major medical journals internationally on the subject of cellular reproduction.

INCOME STATEMENT
YEARS 1 - 3

	YEAR 1	YEAR 2	YEAR 3
Net sales	0	0	0
Cost of goods sold	0	0	0
Gross profits on sales	0	0	0
Operating expenses:			
Selling expenses			
Advertising	0	50 000	100 000
Other	10 260	11 260	11 260
Total	10 260	61 260	111 260
G&A Expenses			
Admin. Salaries	0	0	0
Other	6 000	25 500	25 500
Total	26 600	25 500	25 500
R&D Expenses			
Salaries	25 000	25 000	25 000
Other	20 000	10 000	10 000
Total	45 000	35 000	35 000
Total Operating Expenses	81 260	121 760	171 760
Income From Operations	(81 260)	(121 760)	(171 760)
Interest Expense	0	0	0
Other Operating Income	51 000	41 000	41 000
Total Income Before Taxes	(30 260)	(80 760)	(130 760)
Income Taxes	0	0	0
Net Income	(30 260)	(80 760)	(130 760)

BALANCE SHEET
YEARS 1 - 3

	Year 1	Year 2	Year 3
Current Assets			
Cash/Equivalents	100 000	100 450	165 900
Inventories:			
Raw materials	0	0	0
Work in progress	0	0	0
Finished goods	0	0	0
Total current assets	100 000	100 450	165 900
Plant and equipment	5 000	4 050	13 100
Total assets	105 000	104 500	179 000
Current liabilities			
Accounts payable	0	0	0
Total current liabilities	0	0	0
Notes payable	0	0	0
Total liabilities	0	0	0
Stockholders' equity	135 260	215 520	420 780
Capital stock	(30 260)	(80 760)	(130 760)
Retained earnings	105 000	104 500	179 000
Total liabilities and stockholders equity	105 000	104 500	179 000

INCOME STATEMENT
PROJECTED YEAR 4

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Net sales	64 500	88 500	91 500	55 500	300 000
Cost of goods sold	80 652	117 224	125 062	115 692	438 000
Gross profits on sales	(16 152)	(28 724)	(33 562)	(60 192)	(138 000)
Operating expenses:					
Selling expenses					
Advertising	37 500	37 500	37 500	37 500	
Other	4 300	5 900	6 100	3 700	
Total	41 800	43 400	43 600	41 200	170 000
G&A Expenses					
Admin. Salaries	16 902	16 900	16 899	16 899	
Other	28 356	28 354	28 353	28 353	
Total	45 258	45 254	45 252	45 252	180 000
R&D Expenses					
Salaries	51 000	51 000	51 000	51 000	
Other	12 501	12 501	12 500	12 498	
Total	63 501	63 501	63 500	63 498	254 000
Total Operating Expenses	150 599	152 155	152 352	149 950	605 000
Income From Operations	(166 711)	(180 879)	(185 914)	(210 142)	(748 000)
Interest Expense	(3 990)	(3 990)	(3 990)	(3 992)	(14 000)
Other Operating Income	9 800	9 000	8 400	7 000	34 000
Total Income Before Taxes	(160 901)	(175 869)	(181 504)	(207 134)	(725 000)
Income Taxes	0	0	0	0	0
Net Income	(160 901)	(175 869)	(181 504)	(207 134)	(725 000)

BALANCE SHEET
PROJECTED YEAR 4

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Current Assets				
Cash/Equivalents	628 636	450 536	273 490	75 240
Inventories:				
Raw materials	10 350	12 650	9 775	9 200
Work in progress	17 111	20 481	20 507	18 318
Finished goods	17 111	20 481	20 507	18 318
Total current assets	673 208	504 158	324 279	121 076
Plant and equipment	351 177	335 354	321 533	306 716
Total assets	1 024 385	840 502	645 812	427 792
Current liabilities				
Accounts payable	10 350	12 650	9 775	9 200
Total current liabilities	10 350	12 650	9 775	9 200
Notes payable	395 936	385 622	375 311	365 000
Total liabilities	406 286	398 272	385 086	374 200
Stockholders' equity	1 020 780	1 020 780	1 020 780	1 020 780
Capital stock	(160 901)	(175 869)	(181 504)	(207 134)
Retained earnings	618 099	442 230	260 726	53 592
Total liabilities and stockholders equity	1 024 385	840 502	645 812	427 792

INCOME STATEMENT
PROJECTED YEAR 5

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Net sales	183 000	231 000	237 000	165 000	816 000
Cost of goods sold	63 042	65 342	62 467	61 892	252 743
Gross profits on sales	119 958	165 658	174 533	103 108	563 257
Operating expenses:					
Selling expenses					
Advertising	37 500	37 500	37 500	37 500	
Other	5 490	6 930	7 100	4 950	
Total	42 990	44 430	44 600	42 450	174 470
G&A Expenses					
Admin. Salaries	16 902	16 902	16 902	16 902	
Other	28 356	28 356	28 356	28 356	
Total	45 258	45 258	45 258	45 258	181 032
R&D Expenses					
Salaries	51 000	51 000	51 000	51 000	
Other	12 501	12 501	12 500	12 498	
Total	63 501	63 501	63 501	63 501	254 004
Total Operating Expenses	151 749	153 189	153 359	151 209	609 506
Income From Operations	(31 791)	12 469	21 174	(48 101)	(46 241)
Interest Expense	(3 990)	(3 990)	(3 990)	(3 990)	(15 960)
Other Operating Income	18 000	20 000	19 000	12 000	69 000
Total Income Before Taxes	(17 781)	28 479	36 184)	(40 091)	6 791)
Income Taxes	0	(14 240)	(18 092)	0	(32 332)
Net Income	(17 781)	14 239	18 092	(40 091)	(25 549)

BALANCE SHEET
PROJECTED YEAR 5

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Current Assets				
Cash/Equivalents	(5 005)	2 364	57 586	32 625
Inventories:				
Raw materials	13 800	16 100	13 225	12 650
Work in progress	19 630	30 630	19 630	19 630
Finished goods	19 630	30 630	19 630	19 630
Total current assets	48 055	79 724	110 171	84 535
Plant and equipment	363 119	344 552	325 985	307 418
Total assets	411 174	424 276	436 056	391 953
Current liabilities				
Accounts payable	13 800	16 100	13 225	12 650
Total current liabilities	13 800	16 100	13 225	12 650
Notes payable	361 563	358 126	354 689	351 252
Total liabilities	375 363	374 226	367 914	363 902
Stockholders' equity	1 020 780	1 020 780	1 020 780	1 020 780
Capital stock	(17 781)	14 239	18 092	(40 091)
Retained earnings	35 811	50 050	68 142	28 051
Total liabilities and stockholders equity	411 174	424 276	436 056	391 953

INCOME STATEMENT
PROJECTED YEAR 6

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Net sales	412 750	542 750	549 250	471 250	1 976 000
Cost of goods sold	183 585	208 749	210 325	196 444	799 083
Gross profits on sales	229 165	334 001	338 925	274 086	1 176 987
Operating expenses:					
Selling expenses					
Advertising	40 000	40 000	40 000	40 000	
Other	4 127	5 427	5 492	4 712	
Total	44 127	45 427	45 492	44 712	179 758
G&A Expenses					
Admin. Salaries	17 747	17 747	17 747	17 747	
Other	29 356	29 356	29 356	29 356	
Total	47 103	47 103	47 103	47 103	188 412
R&D Expenses					
Salaries	51 000	51 000	51 000	51 000	
Other	12 501	12 501	12 501	12 501	
Total	63 501	63 501	63 501	63 501	254 004
Total Operating Expenses	154 731	156 031	156 096	155 316	622 174
Income From Operations	74 434	177 970	182 829	119 490	554 623)
Interest Expense	(15 567)	(15 567)	(15 567)	(15 567)	(62 268)
Other Operating Income	18 000	20 000	19 000	12 000	69 000
Total Income Before Taxes	76 867	182 433	186 262	115 923	561 485)
Income Taxes	(38 434)	(91 217)	(93 131)	(57 962)	(280 744)
Net Income	38 433)	91 216	93 131	57 962	280 742)

BALANCE SHEET
PROJECTED YEAR 6

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Current Assets				
Cash/Equivalents	(34 714)	58 034	153 549	213 732
Inventories:				
Raw materials	31 050	33 350	30 475	29 900
Work in progress	19 250	18 018	16 360	14 783
Finished goods	19 250	18 018	16 360	14 783
Total current assets	34 836	127 420	216 744	273 198
Plant and equipment	978 944	946 570	914 146	881 722
Total assets	1 013 830	1 073 990	1 130 890	1 154 920
Current liabilities				
Accounts payable	31 050	33 350	30 475	29 900
Total current liabilities	31 050	33 350	30 475	29 900
Notes payable	916 296	882 940	849 584	816 828
Total liabilities	406 286	398 272	385 086	374 200
Stockholders' equity	1 020 780	1 020 780	1 020 780	1 020 780
Capital stock	38 433	91 216	93 131	- 57 961
Retained earnings	66 484	157 700	250 831	308 792
Total liabilities and stockholders equity	1 013 830	1 073 990	1 130 809	1 154 920

INCOME ST TEMENT
PROJECTED YEAR 7

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Net sales	900 250	1 127 750	1 134 250	1 056 250	4 218 500
Cost of goods sold	274 841	331 335	332 241	318 609	1 257 026
Gross profits on sales	625 409	796 415	802 009	737 641	2 961 474
Operating expenses:					
Selling expenses					
Advertising	50 000	50 000	50 000	50 000	
Other	4 501	5 639	5 671	5 281	
Total	54 501	55 639	55 671	55 281	221 092
G&A Expenses					
Admin. Salaries	18 634	18 634	18 634	18 634	
Other	30 824	30 824	30 824	30 824	
Total	49 458	49 458	49 458	49 458	497 832
R&D Expenses					
Salaries	54 000	54 000	54 000	54 000	
Other	12 676	12 676	12 676	12 676	
Total	66 676	66 676	66 676	66 676	266 704
Total Operating Expenses	170 635	171 773	171 805	171 415	658 628
Income From Operations	454 774	171 733	171 805	566 226	2 275 846)
Interest Expense	(19 776)	(19 776)	(19 776)	(19 776)	(79 104)
Other Operating Income	24 000	26 000	25 000	21 000	96 000
Total Income Before Taxes	458 998	630 866	635 428	567 450	2 292 742)
Income Taxes	(229 499)	(315 433)	(317 714)	(283 725)	(1 146 371)
Net Income	229 499)	315 433	317 714	57 962	1 146 371

BALANCE SHEET
PROJECTED YEAR 7

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Current Assets				
Cash/Equivalents	336 098	649 386	964 467	1 245 895
Inventories:				
Raw materials	65 550	67 850	64 975	64 400
Work in progress	29 534	28 041	26 792	25 375
Finished goods	29 534	28 041	26 792	25 375
Total current assets	460 716	773 318	1 083 026	1 361 045
Plant and equipment	1 132 047	1 092 372	1 052 697	1 013 022
Total assets	1 592 763	2 865 690	2 135 723	2 374 067
Current liabilities				
Accounts payable	65 550	67 850	64 975	64 400
Total current liabilities	65 550	67 850	64 975	64 400
Notes payable	988 922	944 116	899 310	854 504
Total liabilities	1 054 472	1 011 066	964 285	918 904
Stockholders' equity	1 020 780	1 020 780	1 020 780	1 020 780
Capital stock	229 499	315 433	317 714	283 725
Retained earnings	538 291	853 724	1 171 438	1 455 163
Total liabilities and stockholders equity	1 592 763	1 865 690	2 135 723	2 372 067

INCOME STATEMENT
PROJECTED YEAR 7

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Net sales	900 250	1 127 750	1 134 250	1 056 250	4 218 500
Cost of goods sold	274 841	331 335	332 241	318 609	1 257 026
Gross profits on sales	625 409	796 415	802 009	737 641	2 961 474
Operating expenses:					
Selling expenses					
Advertising	50 000	50 000	50 000	50 000	
Other	4 501	5 639	5 671	5 281	
Total	54 501	55 639	55 671	55 281	221 092
G&A Expenses					
Admin Salaries	18 634	18 634	18 634	18 634	
Other	30 824	30 824	30 824	30 824	
Total	49 458	49 458	49 458	49 458	497 832
R&D Expenses					
Salaries	54 000	54 000	54 000	54 000	
Other	12 676	12 676	12 676	12 676	
Total	66 676	66 676	66 676	66 676	266 704
Total Expenses	17 6 5	171 773	171 5	171 415	657 628
Income Before Taxes	4 774	171 733	171 8	5 2	2 275 846)
Provision for Taxes	(19 7 6)	(19 776	19 77)	(19 77)	(79 104)
Effective Tax Rate	1	26 0 0	25	1 0	96 000
Net Income Before Extraordinary Items	4 9	6 866	4	45	92 742)
Extraordinary Items	4	315 4	17 714	7	(1 146 371)
Net Income	9	315 433	7 14		1 146 371

BALANCE SHEET
PROJECTED YEAR 7

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Current Assets				
Cash/Equivalents	336 098	649 386	964 467	1 245 895
Inventories:				
Raw materials	65 550	67 850	64 975	64 400
Work in progress	29 534	28 041	26 792	25 375
Finished goods	29 534	28 041	26 792	25 375
Total current assets	460 716	773 318	1 083 026	1 361 045
Plant and equipment	1 [illegible] 7	1 092 372	1 052 697	1 013 022
Total assets	59 7 3	[illegible] 86 690	2 135 723	2 374 067
	64 75			64 400
	4 9			64 400
	9 31			854 504
				918 904
				1 0[illegible]0 780
			1	283 725
				1 455 163
				2 372 067